

## PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

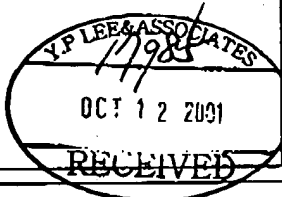
NOTIFICATION OF TRANSMITTAL OF  
INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

( PCT Rule 71.1 )

To:

LEE, Young Pil

Chconghwa Bldg., 1571-18, Seocho-dong, Seocho-gu, Seoul  
137-070, Republic of Korea



Date of mailing  
(day/month/year)

05 OCTOBER 2001 (05.10.2001)

Applicant's or agent's file reference  
TH-14956-PCT

## IMPORTANT NOTIFICATION

International application No.

PCT/KR00/00571

International filing date (day/month/year)

01 JUNE 2000 (01.06.2000)

Priority date (day/months/year)

07 JUNE 1999 (07.06.1999)

Applicant

SHT Co., Ltd. et al

1. The applicant is hereby notified that International Preliminary Examining Authority transmits here with the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**  
The applicant must enter the national phase before each elected office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details in the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/KR

Korean Intellectual Property Office  
Government Complex-Daejeon, Dunsan-dong, Seo-gu,  
Daejeon Metropolitan City 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

COMMISSIONER

Telephone No. 82-42-481-5210



## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TH-14956-PCT	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. <b>PCT/KR00/00571</b>	International filing date (day/month/year) 01 JUNE 2000 (01.06.2000)	Priority date (day/month/year) 07 JUNE 1999 (07.06.1999)
International Patent Classification (IPC) or national classification and IPC  <b>IPC7 B62D 57/02</b>		
Applicant  SHT Co., Ltd. et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of \_\_\_\_\_ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  03 JANUARY 2001 (03.01.2001)	Date of completion of this report  25 SEPTEMBER 2001 (25.09.2001)
Name and mailing address of the IPEA/KR Korean Intellectual Property Office Government Complex-Daejeon, Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer  PARK, Hee Joo  Telephone No. 82-42-481-5438



## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/KR00/00571

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

- ☐ the international application as originally filed
- ☐ the description:  
 pages 1-17 , as originally filed  
 pages \_\_\_\_\_ , filed with the demand  
 pages \_\_\_\_\_ , filed with the letter of \_\_\_\_\_
- ☐ the claims:  
 pages 18-22 , as originally filed  
 pages \_\_\_\_\_ , as amended (together with any statement) under Article 19  
 pages \_\_\_\_\_ , filed with the demand  
 pages \_\_\_\_\_ , filed with the letter of \_\_\_\_\_
- ☐ the drawings:  
 pages 1/21-21/21 , as originally filed  
 pages \_\_\_\_\_ , filed with the demand  
 pages \_\_\_\_\_ , filed with the letter of \_\_\_\_\_
- ☐ the sequence listing part of the description:  
 pages \_\_\_\_\_ , as originally filed  
 pages \_\_\_\_\_ , filed with the demand  
 pages \_\_\_\_\_ , filed with the letter of \_\_\_\_\_

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language English which is

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☒ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheet \_\_\_\_\_

5. ☐ This opinion has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed," and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION

International application No.

PCT/KR00/00571

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims 1-15	YES
	Claims	NO
Inventive step (IS)	Claims 1-15	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-15	YES
	Claims	NO

## 2. Citations and explanations (Rule 70.7)

JP 61-46778 A (MITSUBISHI) 7 MARCH 1986  
 JP 4-104786 U (MITSUBISHI) 9 SEPTEMBER 1992  
 JP 5-49554 A (TOSHIBA) 2 MARCH 1993

## 1. Novelty and Inventive Step

The wall-surface, suction-type, self-propelling device of the cited document (JP 61-46778 A) is comprised of rollers (2, 3), an endless crawler (4), air motors (7, 10), a header pipe (17), air ejectors (18), air suction holes (19) and recesses (5).

The wall-surface, suction-type, self-propelling, robotic device (JP 4-104786 U) is comprised of an air ejector pump (28), a connecting pipe (29), a chain link (20), a pin (21), a bracket (22), a pad base (25), a sealing (26) and a bellows (23).

The wall-surface-washing apparatus with an evacuating-cup (JP 5-49554 A) is comprised of an air compressor (8), a compression air pipe line (9), a nozzle (6), a diffuser (7), a suction air pipe line (14), a check valve (4) and an evacuating cup (2).

Compared to this invention, the above documents do not have vacuum chambers installed on the sides of the wheels.

Therefore, claims 1 and 8 are considered to fulfill the requirement of PCT Article 33(2) and PCT Article 33(3). Claims 2-7 and 9-15 also comply with PCT Article 33(2) and PCT Article 33(3), as they are dependant claims.

## 2. Industrial Applicability

The surface travelling mobile apparatus described in claims 1-15 can be used to travel on a flat plane, an inclined plane, a vertical plane and a ceiling, and to clean the windows of high buildings automatically. So, claims 1-15 possess industrial applicability according to PCT Article 33(4).

## P. TENT COOPERATION TREATY

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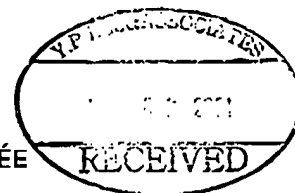
INFORMATION CONCERNING ELECTED  
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

LEE, Young, Pil  
The Cheonghwa Bldg.  
1571-18, Seocho-dong  
Seocho-gu  
Seoul 137-073  
RÉPUBLIQUE DE CORÉE



Date of mailing (day/month/year) 21 February 2001 (21.02.01)		
Applicant's or agent's file reference TH-14956-PCT		IMPORTANT INFORMATION
International application No. PCT/KR00/00571	International filing date (day/month/year) 01 June 2000 (01.06.00)	Priority date (day/month/year) 07 June 1999 (07.06.99)
Applicant SHT CO., LTD. et al		

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

AP : GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW  
EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE  
National : AU, BG, CA, CN, CZ, DE, IL, JP, KP, MN, NO, NZ, PL, RO, RU, SE, SK, US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM  
OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG  
National : AE, AL, AM, AT, AZ, BA, BB, BR, BY, CH, CR, CU, DK, DM, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IN, IS, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MW, MX, PT, SD,  
SG, SI, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No. (41-22) 740.14.35	Authorized officer:  Juan Cruz  Telephone No. (41-22) 338.83.38
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## PATENT COOPERATION TREATY

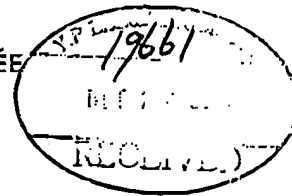
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NOTICE INFORMING THE APPLICANT OF THE  
COMMUNICATION OF THE INTERNATIONAL  
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

LEE, Young, Pil  
The Cheonghwa Bldg.  
1571-18, Seocho-dong  
Seocho-gu  
Seoul 137-073  
RÉPUBLIQUE DE CORÉE

Date of mailing (day/month/year) 14 December 2000 (14.12.00)		IMPORTANT NOTICE	
Applicant's or agent's file reference TH-14956-PCT			
International application No. PCT/KR00/00571	International filing date (day/month/year) 01 June 2000 (01.06.00)	Priority date (day/month/year) 07 June 1999 (07.06.99)	
Applicant SHT CO., LTD. et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:

AU, KP, US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE, AL, AM, AP, AT, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EA, EE, EP, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, OA, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW  
The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 14 December 2000 (14.12.00) under No. WO 00/75000

## REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

## REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer  J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

## PCT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING  
SUBMISSION OR TRANSMITTAL  
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

LEE, Young, Pil  
The Cheonghwa Bldg.  
1571-18, Seocho-dong  
Seocho-gu  
Seoul 137-073  
RÉPUBLIQUE DE CORÉE

Date of mailing (day/month/year) 18 July 2000 (18.07.00)	<b>IMPORTANT NOTIFICATION</b>
Applicant's or agent's file reference TH-14956-PCT	
International application No. PCT/KR00/00571	
International publication date (day/month/year) Not yet published	
Applicant SHT CO., LTD. et al	International filing date (day/month/year) 01 June 2000 (01.06.00)  Priority date (day/month/year) 07 June 1999 (07.06.99)

- The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
- An asterisk (\*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
07 June 1999 (07.06.99)	1999-20978	KR	28 June 2000 (28.06.00)

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

Max Germeil

Telephone No. (41-22) 338.83.38

003415300

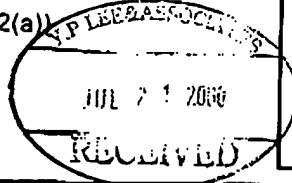
## PCT COOPERATION TREA

PCT

From th INTERNATIONAL BUREAU

NOTIFICATION OF RECEIPT OF  
RECORD COPY

(PCT Rule 24.2(a))



To:

LEE, Young, Pil  
The Cheonghwa Bldg.  
1571-18, Seocho-dong  
Seocho-gu  
Seoul 137-073  
RÉPUBLIQUE DE CORÉE

Date of mailing (day/month/year) 11 July 2000 (11.07.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference TH-14956-PCT	International application No. PCT/KR00/00571

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

SHT CO., LTD. (for all designated States except US)  
TAK, Seung, Ho (for US)

International filing date : 01 June 2000 (01.06.00)

Priority date(s) claimed : 07 June 1999 (07.06.99)

Date of receipt of the record copy  
by the International Bureau : 26 June 2000 (26.06.00)

List of designated Offices :

AP : GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE

OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

National : AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW

## ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase  
☒ confirmation of precautionary designations  
☒ requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:

R. Chrem

Telephone No. (41-22) 338.83.38

ANNEX 1 FORM PCT/IB/301

International application No.

PCT/KR00/00571

## INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated in the Notification of Receipt of Record Copy (Form PCT/IB/301) by paying national fees and furnishing translations, as prescribed by the applicable national laws.

The time limit for performing these procedural acts is **20 MONTHS** from the priority date or, for those designated States which the applicant elects in a demand for international preliminary examination or in a later election, **30 MONTHS** from the priority date, provided that the election is made before the expiration of 19 months from the priority date. Some designated (or elected) Offices have fixed time limits which expire even later than 20 or 30 months from the priority date. In other Offices an extension of time or grace period, in some cases upon payment of an additional fee, is available.

In addition to these procedural acts, the applicant may also have to comply with other special requirements applicable in certain Offices. It is the applicant's responsibility to ensure that the necessary steps to enter the national phase are taken in a timely fashion. Most designated Offices do not issue reminders to applicants in connection with the entry into the national phase.

For detailed information about the procedural acts to be performed to enter the national phase before each designated Office, the applicable time limits and possible extensions of time or grace periods, and any other requirements, see the relevant Chapters of Volume II of the PCT Applicant's Guide. Information about the requirements for filing a demand for international preliminary examination is set out in Chapter IX of Volume I of the PCT Applicant's Guide.

GR and ES became bound by PCT Chapter II on 7 September 1996 and 6 September 1997, respectively, and may, therefore, be elected in a demand or a later election filed on or after 7 September 1996 and 6 September 1997, respectively, regardless of the filing date of the international application. (See second paragraph above.)

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

## CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date. If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with an indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.

## REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 16-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 16-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity to furnish the priority document within a time limit which is reasonable under the circumstances.

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

## PCT

## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference  
(if desired) (12 characters maximum)

TH-14956-PCT

Box No. I	TITLE OF INVENTION SURFACE-TRAVELLING MOBILE APPARATUS AND CLEANING APPARATUS USING THE SAME	
Box No. II	APPLICANT	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)		<input type="checkbox"/> This person is also inventor.
SHT Co., Ltd. 138-112 Seoul National University, Shinlim-dong Kwanak-gu, Seoul, 151-742 Republic of Korea		Telephone No. 02) 882-8248 Facsimile No. 02) 882-0470 Teleprinter No.
State (that is, country) of nationality: KR		State (that is, country) of residence: KR
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input checked="" type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box		
Box No. III	FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)		This person is: <input type="checkbox"/> applicant only <input checked="" type="checkbox"/> applicant and inventor <input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)
TAK Seung Ho 4-105 Plaza Apt., Kil-dong, Kangdong-gu, Seoul 134-768 Republic of Korea		
State (that is, country) of nationality: KR		State (that is, country) of residence: KR
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box		
<input type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.		
Box No. IV	AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:		<input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)		Telephone No. 02) 588-8585 Facsimile No. 02) 588-8547 Teleprinter No.
LEE Young Pil The Cheonghwa Bldg., 1571-18 Seocho-dong Seocho-gu, 137-070 Republic of Korea		
<input type="checkbox"/> Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.		

Sheet No 2

## Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

## Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):


- |  |  |
|--|--|
| <input checked="" type="checkbox"/> AE United Arab Emirates                  | <input checked="" type="checkbox"/> LR Liberia                                   |
| <input checked="" type="checkbox"/> AL Albania                               | <input checked="" type="checkbox"/> LS Lesotho                                   |
| <input checked="" type="checkbox"/> AM Armenia                               | <input checked="" type="checkbox"/> LT Lithuania                                 |
| <input checked="" type="checkbox"/> AT Austria                               | <input checked="" type="checkbox"/> LU Luxembourg                                |
| <input checked="" type="checkbox"/> AU Australia                             | <input checked="" type="checkbox"/> LV Latvia                                    |
| <input checked="" type="checkbox"/> AZ Azerbaijan                            | <input checked="" type="checkbox"/> MA Morocco                                   |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina                | <input checked="" type="checkbox"/> MD Republic of Moldova                       |
| <input checked="" type="checkbox"/> BB Barbados                              | <input checked="" type="checkbox"/> MG Madagascar                                |
| <input checked="" type="checkbox"/> BG Bulgaria                              | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BR Brazil                                |  |
| <input checked="" type="checkbox"/> BY Belarus                               | <input checked="" type="checkbox"/> MN Mongolia                                  |
| <input checked="" type="checkbox"/> CA Canada                                | <input checked="" type="checkbox"/> MW Malawi                                    |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein  | <input checked="" type="checkbox"/> MX Mexico                                    |
| <input checked="" type="checkbox"/> CN China                                 | <input checked="" type="checkbox"/> NO Norway                                    |
| <input checked="" type="checkbox"/> CR Costa Rica                            | <input checked="" type="checkbox"/> NZ New Zealand                               |
| <input checked="" type="checkbox"/> CU Cuba                                  | <input checked="" type="checkbox"/> PL Poland                                    |
| <input checked="" type="checkbox"/> CZ Czech Republic                        | <input checked="" type="checkbox"/> PT Portugal                                  |
| <input checked="" type="checkbox"/> DE Germany                               | <input checked="" type="checkbox"/> RO Romania                                   |
| <input checked="" type="checkbox"/> DK Denmark                               | <input checked="" type="checkbox"/> RU Russian Federation                        |
| <input checked="" type="checkbox"/> DM Dominica                              | <input checked="" type="checkbox"/> SD Sudan                                     |
| <input checked="" type="checkbox"/> EE Estonia                               | <input checked="" type="checkbox"/> SE Sweden                                    |
| <input checked="" type="checkbox"/> ES Spain                                 | <input checked="" type="checkbox"/> SG Singapore                                 |
| <input checked="" type="checkbox"/> FI Finland                               | <input checked="" type="checkbox"/> SI Slovenia                                  |
| <input checked="" type="checkbox"/> GB United Kingdom                        | <input checked="" type="checkbox"/> SK Slovakia                                  |
| <input checked="" type="checkbox"/> GD Grenada                               | <input checked="" type="checkbox"/> SL Sierra Leone                              |
| <input checked="" type="checkbox"/> GE Georgia                               | <input checked="" type="checkbox"/> TJ Tajikistan                                |
| <input checked="" type="checkbox"/> GH Ghana                                 | <input checked="" type="checkbox"/> TM Turkmenistan                              |
| <input checked="" type="checkbox"/> GM Gambia                                | <input checked="" type="checkbox"/> TR Turkey                                    |
| <input checked="" type="checkbox"/> HR Croatia                               | <input checked="" type="checkbox"/> TT Trinidad and Tobago                       |
| <input checked="" type="checkbox"/> HU Hungary                               | <input checked="" type="checkbox"/> TZ United Republic of Tanzania               |
| <input checked="" type="checkbox"/> ID Indonesia                             | <input checked="" type="checkbox"/> UA Ukraine                                   |
| <input checked="" type="checkbox"/> IL Israel                                | <input checked="" type="checkbox"/> UG Uganda                                    |
| <input checked="" type="checkbox"/> IN India                                 | <input checked="" type="checkbox"/> US United States of America                  |
| <input checked="" type="checkbox"/> IS Iceland                               |  |
| <input checked="" type="checkbox"/> JP Japan                                 | <input checked="" type="checkbox"/> UZ Uzbekistan                                |
| <input checked="" type="checkbox"/> KE Kenya                                 | <input checked="" type="checkbox"/> VN Viet Nam                                  |
| <input checked="" type="checkbox"/> KG Kyrgyzstan                            | <input checked="" type="checkbox"/> YU Yugoslavia                                |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | <input checked="" type="checkbox"/> ZA South Africa                              |
| <input type="checkbox"/> KR Republic of Korea                                | <input checked="" type="checkbox"/> ZW Zimbabwe                                  |
| <input checked="" type="checkbox"/> KZ Kazakhstan                            |  |
| <input checked="" type="checkbox"/> LC Saint Lucia                           |  |
| <input checked="" type="checkbox"/> LK Sri Lanka                             |  |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

- ☐ .....
- ☐ .....

**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

Sheet No. 3

<b>Box No. VI PRIORITY CLAIM</b>					<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:			
		national application: country	regional application: regional Office	international application: receiving Office	
item (1) 7. June 1999 (07.06.99)	1999-20978	KR			
item (2)					
item (3)					
<input type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s). * Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.					
<b>Box No. VII INTERNATIONAL SEARCHING AUTHORITY</b>					
<b>Choice of International Searching Authority (ISA)</b> (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen: the two-letter code may be used)		<b>Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority)</b> Date (day/month/year)      Number      Country (or regional Office)			
ISA / KR					
<b>Box No. VIII CHECK LIST: LANGUAGE OF FILING</b>					
This international application contains the following number of sheets: request : 3 description (excluding sequence listing part) : 8 claims : 3 abstract : 1 drawings : 21 sequence listing part of description : Total number of sheets : 36		This international application is accompanied by the item(s) marked below: 1. <input checked="" type="checkbox"/> fee calculation sheet 2. <input checked="" type="checkbox"/> separate signed power of attorney 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: 4. <input type="checkbox"/> statement explaining lack of signature 5. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 6. <input type="checkbox"/> translation of international application into (language): 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form 9. <input type="checkbox"/> other (specify):			
Figure of the drawings which should accompany the abstract: Fig. 1		Language of filing of the international application: Korean			
<b>Box No. IX SIGNATURE OF APPLICANT OR AGENT</b>					
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).  <div style="text-align: center;">           LEE Young Pil  </div>					
For receiving Office use only					
1. Date of actual receipt of the purported international application:		2. Drawings:			
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		<input type="checkbox"/> received:			
4. Date of timely receipt of the required corrections under PCT Article 11(2):		<input type="checkbox"/> not received:			
5. International Searching Authority (if two or more are competent): ISA /		6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.			
For International Bureau use only					
Date of receipt of the record copy by the International Bureau:					

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>TH-14956-PCT</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, Item 5 below.	
International application No. <b>PCT/KR00/00571</b>	International filing date (day/month/year) <b>01 JUNE 2000 (01.06.2000)</b>	(Earliest) Priority Date (day/month/year) <b>07 JUNE 1999 (07.06.1999)</b>
Applicant <b>SHT Co., Ltd. et al</b>		

This International search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets

☐ It is also accompanied by a copy of each prior art document cited in this report

## 1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form

☐ filed together with the international application in computer readable form

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I)

3. ☐ Unity of invention is lacking (See Box II).

4. With regard to the title,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows.

Vacuum Adsorption Moving Device with Cleaning System

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawing to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☐ None of the figures

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/KR00/00571**A. CLASSIFICATION OF SUBJECT MATTER**

IPC7 B62D 57/02, A47L 11/30

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC7 B62D 57/02, A47L 11/30, A47L 11/40

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Korean Patents and applications for inventions since 1975, Korean Utility models and applications for Utility models since 1975  
Japanese Utility models and applications for Utility models since 1975Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
PAJ. DERWENT "moving device & cleaning system"**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 61-46778 A (MITSUBISHI) 7 MARCH 1986 page 528, column 2, line 9 to 38	1
A	JP 4-104786 U (MITSUBISHI) 9 SEPTEMBER 1992 claim 1	1
A	JP 5-49554 A (TOSHIBA) 2 MARCH 1993 claim 1	8

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

15 SEPTEMBER 2000 (15.09.2000)

Date of mailing of the international search report

16 SEPTEMBER 2000 (16.09.2000)

Name and mailing address of the ISA/KR

Korean Industrial Property Office  
Government Complex-Taejon, Dunsan-dong, So-ku, Taejon  
Metropolitan City 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

OH, Se Gye

Telephone No. 82-42-481-5436



## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under Article 19. The Notes are based on the requirements of the Patent Cooperation Treaty and of the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule" and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

#### What parts of the international application may be amended ?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Preliminary Examination Authority.

Upon entry into the national phase, all part of the international application may be amended under Article 28 or, where applicable, Article 41.

**When ?** Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the application time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments ?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

**How ?** Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are numbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

#### What documents must/may accompany the amendments ?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amendment claims. It should not be confounded with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

**NOTES TO FORM PCT/ISA/220 (continued)**

**The following examples illustrate the manner in which amendments must be explained in the accompanying letter:**

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:  
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same manners; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:  
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in canceling some claims and in adding new claims]:  
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or  
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:  
"Claims 1 - 10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

**"Statement under Article 19(1)" (Rule 46.4)**

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawing (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

The statement should be brief, it should not exceed 500 word if in English or if translated into English.

It should not be confounded with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It should not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

**In what language ?**

The amendments must be made in the language in which the international application is published. The letter and any statement accompanying the amendments must be in the same language as the international application if that language is English or French; otherwise, it must be in English or French, at the choice of the applicant.

**Consequence if a demand for international preliminary examination has already been filed ?**

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

**Consequence with regard to translation of the international application for entry into the national phase ?**

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

(19) World Intellectual Property Organization  
International Bureau



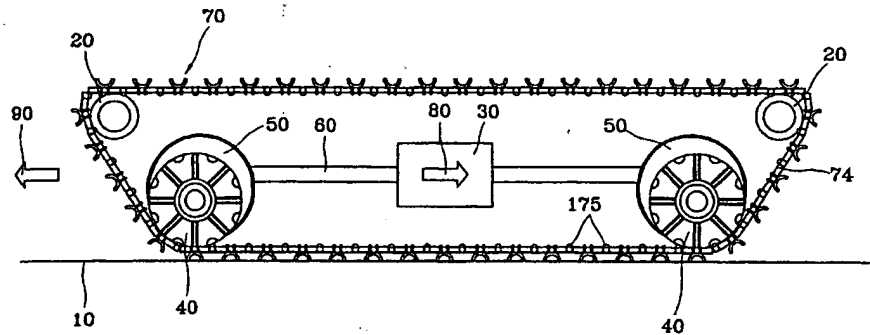
(43) International Publication Date  
14 December 2000 (14.12.2000)

PCT

(10) International Publication Number  
WO 00/75000 A1

- (51) International Patent Classification<sup>7</sup>: B62D 57/02, A47L 11/30
- (74) Agent: LEE, Young, Pil; The Cheonghwa Bldg., 1571-18, Seocho-dong, Seocho-gu, Seoul 137-073 (KR).
- (21) International Application Number: PCT/KR00/00571
- (22) International Filing Date: 1 June 2000 (01.06.2000)
- (25) Filing Language: Korean
- (26) Publication Language: English
- (30) Priority Data:  
1999/20978 7 June 1999 (07.06.1999) KR
- (71) Applicant (for all designated States except US): SHT CO., LTD. [KR/KR]; 138-112 Seoul National University, Shinlim-dong, Kwanak-gu, Seoul, 151-742 (KR).
- (81) Designated States (national): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— With international search report.
- (72) Inventor; and  
(75) Inventor/Applicant (for US only): TAK, Seung, Ho [KR/KR]; 4-105 Plaza Apt., Kil-dong, Kangdong-gu, Seoul 134-768 (KR).
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: VACUUM ADSORPTION MOVING DEVICE WITH CLEANING SYSTEM



(57) Abstract: A surface traveling mobile apparatus which moves by an endless track belt installed to be wrapped around a case from end to end, traveling on a surface by the rotation of wheels driven by a power source is provided. The surface traveling mobile apparatus includes vacuum chambers installed to be attached to the sides of the wheels, a vacuum tube for connecting the vacuum chambers to each other, a vacuum pump formed in part of the vacuum tube, the vacuum pump for inhaling and exhausting air, and suction mechanisms installed along the endless track belt at predetermined intervals, valve driven by contacting the wheels, and vacuum attached to the surface by the vacuum pump inhaling and exhausting air. Also, a cleaning apparatus including a spray unit for spraying water or wash liquid to the surface when the surface traveling mobile apparatus moves, and a rotating brush for washing the surface using the sprayed liquid, are provided. Accordingly, the surface traveling apparatus and the cleaning apparatus using the same can freely travel a plane, an inclined plane, a vertical plane, and a ceiling and thus, can clean areas which are not easily cleaned by people, such as windows or high buildings and high ceilings.

WO 00/75000 A1

## VACUUM ADSORPTION MOVING DEVICE WITH CLEANING SYSTEM

Technical Field

5       The present invention relates to a surface traveling mobile apparatus and a cleaning apparatus using the same, and more particularly, to a surface traveling mobile apparatus which travels on a flat plane such as a floor, an inclined plane such as a ramp, a vertical plane such as a window or a marble wall, travels upside down on a flat plane such as a ceiling, and  
10       can travel over rough surfaces and obstacles, and a cleaning apparatus using the same.

Background Art

Conventional surface traveling mobile apparatuses such as cars,  
15       which constitute a load due to their weight, can be moved by drivers by means of wheels or endless track belts only within a range of angles achieved by a certain amount of climbing capability. In order to move surface traveling mobile apparatuses at steep angles against gravity, additional propellers similar to those attached to rockets or additional  
20       ascending and descending units and supporters are necessary.

Also, conventionally, walls and windows are cleaned by people who work at high places, which involves difficulties. The walls and windows can be cleaned by robots. However, robots have not been commonly used since they are expensive. Therefore, cleaning apparatuses for  
25       automatically cleaning floors or windows using surface traveling mobile apparatuses which can freely travel on an inclined plane, a vertical plane, and a ceiling are necessary.

Disclosure of the Invention

30       It is an object of the present invention to provide a surface traveling mobile apparatus which can freely travel on a plane, an inclined plane, a

vertical plane, and a ceiling.

It is another object of the present invention to provide a surface traveling mobile apparatus including a supplementary device for letting the surface traveling mobile apparatus travel over an obstacle and on a rugged  
5 surface.

It is another object of the present invention to provide a cleaning apparatus including the surface traveling mobile apparatus equipped with a sprayer for spraying water or wash liquid on a surface to be cleaned or a rotating brush for wiping a surface to be cleaned using sprayed liquid.

10 It is another object of the present invention to provide a surface traveling mobile apparatus equipped with a sensor for sensing a limit load display code of a vertical wall and a ceiling.

Accordingly, to achieve the above objects, there is provided a surface traveling mobile apparatus which moves by an endless track belt  
15 installed to be wrapped around a case from end to end traveling on a surface by the rotation of wheels driven by a power source, the surface traveling mobile apparatus comprising vacuum chambers installed to be attached to the sides of the wheels, a vacuum tube for connecting the vacuum chambers to each other, a vacuum pump formed in part of the  
20 vacuum tube, the vacuum pump for inhaling and exhausting air, and suction mechanisms installed along the endless track belt at predetermined intervals, valve driven by contacting the wheels, and vacuum attached to the surface by the vacuum pump inhaling and exhausting air.

There is provided a cleaning apparatus for automatically cleaning a  
25 surface by being moved by a surface traveling mobile apparatus which moves by an endless track belt installed to be wrapped around a case from end to end traveling on the surface by the rotation of wheels driven by a power source, the cleaning apparatus comprising vacuum chambers installed to be attached and sealed to the sides of the wheels, a vacuum  
30 tube for connecting the vacuum chambers to each other, a vacuum pump formed in part of the vacuum tube, the vacuum pump for pumping air,

suction mechanisms installed along the endless track belt at predetermined intervals, valve driven by contacting the wheels, and vacuum attached to the surface by the action of the vacuum pump, a spray means for spraying water or wash liquid on a surface when the surface traveling mobile  
5 apparatus moves, and a rotating brush for washing the surface using the sprayed liquid.

The vacuum pump preferably comprises a motor for generating rotatory force, a rotating magnet, in which the N pole and the S pole are alternately arranged and which is rotated by the rotatory force of the motor,  
10 the rotating magnet for generating different magnetic fields, a fixed magnet arranged to be opposite to the rotating magnet, a pump having a diaphragm operating by the attraction and repulsion between the rotating magnet and the fixed magnet, a vacuum chamber, the air inside of which is pumped due to the movement of the diaphragm, and directional valves installed in  
15 openings at both ends of the vacuum chamber, the one directional valves for permitting the pumped air to flow in one direction.

Each of the suction mechanism preferably comprises a hollow valve case formed to be integrated with the endless track belt, a valve driver coming in and coming out from at least part of the valve case by contacting  
20 the wheels, a lever operated by the valve driver coming in and coming out from the valve case, a ball moving up and down in the hollow portion of the valve case by the operation of the lever, a spring installed to contact the upper portion of the ball in the hollow portion, the spring for providing an elastic bias, and a flexible body formed to be integrated with the lower  
25 portion of the valve case and vacuum attached to or detached from a surface by evacuating the air therein or supplying air thereinto through a lower O ring opening of the valve case due to the operation of the ball valve.

Each of the suction mechanism preferably further comprises a  
30 separation preventing groove so that the valve driver in the valve case is not separated from the valve case.

The cleaning apparatus preferably further comprises an articulated apparatus having a boom, which can be telescopically extended and retracted, and a suction mechanism for being vacuum attached to and detached from a surface, which is formed in the suction mechanism at the end of a boom in the articulated apparatus, so that the surface traveling mobile apparatus safely travels on a rugged surface or over an obstacle.

The cleaning apparatus preferably further comprises a belt tension controlling apparatus for controlling the tension of the endless track belt in part of the surface traveling mobile apparatus so that the surface traveling mobile apparatus safely travels a rugged surface or over an obstacle.

Each of the wheels preferably comprises grooves for preventing the wheel from being separated from the endless track belt when the wheel contacts the endless track belt and an opening for letting air flow between the wheel and the suction mechanism to the vacuum chamber.

15

#### Brief Description of the Drawings

The above objects and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 is a side sectional view schematically showing a surface traveling mobile apparatus according to a preferred embodiment of the present invention;

FIG. 2 is a side sectional view showing the closed state of a ball valve in a suction mechanism adopted in FIG. 1 which includes a flexible body and a ball valve structure suction unit;

FIG. 3 is a side sectional view showing the opened state of the ball valve of FIG. 2;

FIG. 4A is a side sectional view showing wheels and a vacuum chamber which are adopted in FIG. 1;

FIG. 4B is a perspective view showing a single wheel unit;

FIG. 4C is a perspective view showing an entire wheel having four

single wheel units;

FIG. 5 illustrates a principle with which a front wheel adopted in FIG. 1 travels on an endless track belt;

FIG. 6 illustrates a principle with which a rear wheel adopted in FIG. 1 travels on an endless track belt;

FIG. 7A is a plan view of the endless track belt shown in FIG. 1;

FIG. 7B is a front view of the wheel shown in FIG. 1;

FIG. 8 is a side view schematically showing a surface traveling mobile apparatus according to another embodiment of the present invention, in which the surface traveling mobile apparatus further includes units for controlling the tension of a belt when the surface traveling mobile apparatus travels on a rugged surface and over an obstacle;

FIG. 9A is a plan view schematically showing a surface traveling mobile apparatus according to another embodiment of the present invention, in which the surface traveling mobile apparatus further includes an articulated apparatus with an extendable boom structure when the surface traveling mobile apparatus of FIG. 1 travels on a rugged surface and over an obstacle;

FIG. 9B is a side view showing an articulated apparatus whose length is extended;

FIGS. 10A through 10D illustrate the rugged surface or obstacle traveling movements of the surface traveling mobile apparatus according to the present invention;

FIGS. 11A through 11C illustrate the structure and operation of a vacuum pump applied to the present invention;

FIGS. 12A through 12D illustrate the proceeding, receding, and direction changing movements of the surface traveling mobile apparatus according to the present invention;

FIG. 13 schematically shows an example, in which the surface traveling mobile apparatus according to the present invention cleans a vertical window;

FIGS. 14A and 14B are a plan view and a side view, respectively, of a window to which a transparent bar code, which transmits a visible ray and totally reflects certain wavelengths in the infrared region, is attached; and

FIG. 15 is a view of the underside of a traveling mobile apparatus  
5 according to the present invention, from which an endless track belt is omitted.

#### Best mode for carrying out the Invention

Hereinafter, preferred embodiments of a surface traveling mobile  
10 apparatus according to the present invention and a cleaning apparatus using the same will be described in more detail with reference to the attached drawings. The same reference numerals appearing in different drawings represent the same element.

FIG. 1 is a side view of a surface traveling mobile apparatus  
15 according to an embodiment of the present invention. The power transmission structure and the case structure of the surface traveling mobile apparatus are not shown in FIG. 1, since they are not directly related to the present invention. Only wheels, a track belt, a vacuum pump, and suction mechanisms are schematically shown. FIG. 1 shows the  
20 surface traveling mobile apparatus which moves by an endless track belt 74 installed to be wrapped around the case (not shown) from end to end, traveling on a surface 10 due to the rotation of wheels 40, similar to military tanks and armored motorcars. The surface traveling mobile apparatus of FIG. 1 includes vacuum chambers 50 installed to be attached to the sides  
25 of the wheels 40, a vacuum tube 60 for connecting the vacuum chambers 50 to each other, a vacuum pump 30 formed in part of the vacuum tube 60, for inhaling air and then, exhausting air, and suction mechanisms 70 which are installed at predetermined intervals along the endless track belt, are valve driven by contacting the wheels 40, and are vacuum attached to the  
30 surface 10 due to the inhaling and exhausting of air by the vacuum pump 30. Also, the surface traveling mobile apparatus according to the present

invention includes supporting rollers 20 in the corners of the endless track belt 74, for smoothly rotating and supporting the endless track belt 74. The supporting rollers 20 maintain the angle formed by belt contact surfaces.

FIG. 2 is a side sectional view showing the closed state of a ball  
5 valve in a suction mechanism adopted in FIG. 1, which includes a flexible body and a ball valve structure suction unit. FIG. 3 is a side sectional view showing the opened state of the ball valve of FIG. 2. As shown in FIGS. 1 through 3, when the body 42 of the wheel 40 presses valve drivers 82, the valve drivers operate levers 75, thus lifting a ball 77 supported by the  
10 levers 75. Accordingly, a spring 78 is compressed. A hemispherical flexible body 71, which is formed of rubber or silicon and whose inside is empty, is vacuum attached to the surface 10 since the air is exhausted from the hemispherical space inside through the openings of O rings 76 and a crack between the lifted ball 77 and the lever 75. Here, the levers 75 are  
15 fixed to a valve case 72 by fixers 73. The valve case 72 is formed to be integrated with the endless track belt along the endless track belt. At this time, valve drivers 82 move in a state in which the protrusions of the valve drivers 82 are confined to separation preventing grooves 79 formed in the valve case 72 so that the valve drivers 82 are not separated from the valve  
20 case 72. Therefore, as shown in FIG. 2, the air is exhausted from the suction mechanism 70 which does not contact the wheel since the ball valve is kept closed. Accordingly, the flexible body 71 is maintained in the state of being vacuum attached to the surface. As shown in FIG. 3, the air is sucked into the suction mechanism 70 which contacts the wheel since  
25 the ball valve is kept opened. Accordingly, the flexible body is detached from the surface. At this time, as shown in FIG. 1, the vacuum pump 30 installed in the middle of the vacuum tube 60 for connecting the wheels 40 to each other, sucks in air from the flexible body of the suction mechanism shown in FIG. 3 and exhausts the air to the vacuum attached flexible body  
30 shown in FIG. 2, thus detaching the flexible body from the surface. The vacuum pump 30 sucks in air from the flexible body 71 or supplies air to the

flexible body 71 through the vacuum chambers 50 attached to the sides of the wheels 40 and the vacuum tube 60. As shown in FIG. 1, when the wheels contact the flexible body 71 due to the rotation of the endless track belt, the vacuum pump 30 inhales the air from the contacted flexible body 71 in an arrow direction 80, thus vacuum attaching the flexible body 71 to the surface and exhausts air to the flexible body 71 on the other side, thus detaching the flexible body from the surface. Accordingly, the surface traveling mobile apparatus moves in an arrow direction 90.

The structure of the wheel 40 which rotates, while being engaged with the endless track belt 74 is shown in FIGS. 4A through 4C. FIG. 4A is a side sectional view showing the wheel and the vacuum chamber which are adopted in FIG. 1. FIG. 4B is a perspective view showing a single unit wheel. FIG. 4C is a perspective view showing the entire wheel consisting of four single unit wheels. As shown in FIGS. 4A through 4C, in the structure of the wheel 40 applied to the present invention, grooves 44 for preventing the wheel 40 from sliding on the endless track belt 74, by being engaged with protrusions 175 (of FIG. 1) of the endless track belt 74, are provided on the surface of a cylinder. In the cylindrical wheel 40, a plurality of, preferably eight, semicircular grooves 46 are formed from the circumference of the wheel 40 to the center of the wheel 40. Accordingly, the air sucked in from the inside of the flexible body is transmitted to the vacuum chamber 50 through a vacuum ring 47 and is supplied to the flexible body of the other side through an inlet 48 of the vacuum chamber 50, which is connected to the vacuum tube 60. A shaft groove 49, to which a power transmission shaft is connected, is formed in the center of the wheel. As shown in FIG. 4C, since the single unit wheels, each of which is shown in FIG. 4B, are stacked, the semicircular grooves 46 form circular grooves 46. When the body 42 of the wheel 40 contacts the valve driver 82 of the suction mechanism, the groove 46 contacts the opening of the suction mechanism. Accordingly, air is sucked in. Here, the wheels are stacked to form three grooves 46. However, the number of grooves can be

controlled to be appropriate according to the width of the endless track belt, for example, two or four or more. Also, as shown in FIG. 4C, in the entire wheel consisting of the single unit wheels, each of the single unit wheels stacked in the middle of the entire wheel is formed to have semicircular  
5 grooves on both top and bottom surfaces.

The principles of how the surface traveling mobile apparatus according to the present invention travels along the endless track will now be described. FIG. 5 illustrates the principle by which a front wheel adopted in FIG. 1 travels on an endless track belt. FIG. 6 illustrates the  
10 principle by which a rear wheel adopted in FIG. 1 travels on the endless track belt. FIG. 7A is a plan view of the endless track belt shown in FIG. 1. FIG. 7B is a front view of the wheel shown in FIG. 1.

It is apparent to anyone skilled in the art that the wheels which rotate inside the endless track belt are driven by power sources, and that electric  
15 engines for which electric power sources such as commercial power supplies and batteries are used and chemical fuel engines for which fossil fuels such as gasoline and light oil are used, are used as the power sources. Therefore, a detailed description of a powering mechanism will be omitted. The surface traveling mobile apparatus and the cleaning  
20 apparatus using the same, from the stage where the wheels are driven by power, will now be described.

The wheel positioned in the front part in the traveling direction of the surface traveling mobile apparatus is referred to as a front wheel and the wheel positioned in the rear part is referred to as a rear wheel. In the  
25 wheel of FIG. 7B, when the body 42 of the front wheel 40 presses the valve driver 82 of the suction mechanism due to the rotation of the endless track belt of FIG. 7A, as shown in FIG. 5, the air is exhausted from a flexible body Wa in the direction A1, since the ball valve is opened. Accordingly, the hemispherical space of the flexible body Wa becomes vacuum S1, and  
30 thus the flexible body Wa is vacuum attached to the surface 10. The moment which the wheel passes over the valve driver 82 of the suction unit,

the ball valve is closed, thus keeping the hemispherical space of the flexible body Wb vacuum S2. Accordingly, the flexible body Wb is vacuum attached to the surface 10. Here, the air sucked in from the suction mechanism to a vacuum chamber 52 is supplied to the flexible body on the  
5 opposite side through a vacuum tube in the direction A2.

As shown in FIG. 6, the rear wheel undergoes processes similar to the above, thus sequentially contacting the suction mechanisms as the endless track belt proceeds. The flexible body Wb of the suction unit which contacts the wheel is detached from the surface since the ball valve is  
10 opened, and thus air B2 supplied from the vacuum pump in the direction B1 is supplied to the hemispherical space S3 of the flexible body which was kept vacuum S2, in the direction B2. The flexible body Wa over which the wheel passed S4 is continuously kept detached from the surface.

As mentioned above, the surface traveling mobile apparatus  
15 according to the present invention can travel on a level plane, a vertical plane and a ceiling, as well as on an inclined plane, in a state of being vacuum attached to the surface by a plurality of flexible bodies formed on the bottom surface of the surface traveling mobile apparatus being repeatedly vacuum attached to and detached from the surface according to  
20 the rotation of the endless track belt and the wheels. An important point to be considered is whether the surface, on which the surface traveling mobile apparatus travels in the state of being vacuum attached thereto, can withstand the load of the surface traveling mobile apparatus, and whether the attachment force by which the surface traveling mobile apparatus is  
25 vacuum attached to the surface can carry the load of the surface traveling mobile apparatus. It depends on the capability of the vacuum pump and the attachment strength to the surface. Manufacturing a desired surface traveling mobile apparatus by designing the suction mechanism considering the weight of the surface traveling mobile apparatus is a matter  
30 of design left to those skilled in the art. Therefore, a description thereof will be omitted. Though not shown in the attached drawings, it is preferable

that the surface traveling mobile apparatus be supported by an additional supporting means to further insure that the surface traveling mobile apparatus does not fall when it travels on a vertical plane or a ceiling. Since this is also a matter of design, a description thereof will be omitted.

5        FIG. 8 is a side view schematically showing a surface traveling mobile apparatus according to another embodiment of the present invention, in which the surface traveling mobile apparatus further includes units for controlling the tension of a belt when the surface traveling mobile apparatus of FIG. 1 travels on a rugged surface or over an obstacle. The  
10        endless track belt 74 of the surface traveling mobile apparatus according to the present invention must maintain a certain amount of tension. However, it is not easy to travel on rugged surfaces or stairs when tension is too strong. Therefore, as shown in FIG. 8, it is possible to control the tension of the endless track belt by providing a belt tension controller 100 on the  
15        endless track. The belt tension controller 100 is installed to be supported by the lower surface of the endless track belt 74, to thus move up and down, though not shown in FIG. 8. Therefore, the tension of the belt increases when the belt tension controller 100 moves up, and the tension of the belt decreases when the belt tension controller 100 moves down.  
20        Accordingly, it is possible to control the tension of the belt according to the shape of the rugged surface, in the surface traveling mobile apparatus according to the present invention. The tension of the belt is controlled by a sensing means for sensing the rugged surface, and a microcomputer (not shown) for giving commands based on sensed information on the rugged  
25        surface from the sensing means to the belt tension controller 100. Since the above is apparent to those skilled in the art, a detailed description thereof will be omitted.

FIG. 9A is a plan view schematically showing a surface traveling mobile apparatus according to another embodiment of the present  
30        invention, in which the surface traveling mobile apparatus further includes an articulated apparatus of an extendable ladder structure when the

surface traveling mobile apparatus of FIG. 1 travels on a rugged surface or over an obstacle. FIG. 9B is a plan view showing an articulated apparatus whose length is extended. FIGS. 10A through 10D illustrate the rugged surface traveling movements of the surface traveling mobile apparatus according to the present invention. As shown in FIGS. 9A, 9B, and 10A through 10D, when the surface traveling mobile apparatus according to the present invention travels over an obstacle, the means for sensing the obstacle and the microcomputer for giving commands for traveling over the obstacle are not shown, as mentioned with regard to the belt tension controller. Since it is apparent to those skilled in the art, a detailed description thereof will be omitted. When the obstacle is sensed, the surface traveling mobile apparatus according to the present invention operates an extendable articulated apparatus 200 in the traveling direction, thus extending a portion of the articulated apparatus which will be called the boom. The boom can extend telescopically. A vacuum pump motor 202 is included in the end of the boom and a flexible body 204 is suspended from the lower end of the vacuum pump motor 202. The flexible body 204 attaches to the surface. When a driver 206 of the articulated apparatus operates, the boom is extended, and attaches to the surface. The attached flexible body is vacuum attached to the surface due to the forward rotation of the vacuum pump motor 202 and is detached from the surface due to the reverse rotation of the vacuum pump motor 202, though not shown in FIGS. 9A through 10D. The flexible body 204 is an external flexible body. Internal flexible bodies 208 and 210 are included inside the flexible body 204. It is important to maintain a strong attachment so that the attachment force withstands the load of the surface traveling body when the articulated apparatus 200 retracts the boom so as to let the surface traveling mobile apparatus travel over an obstacle 15 by lifting the body of the surface traveling mobile apparatus T. A rotating brush 300 is included at the end of the boom for cleaning the surface. Though not shown in the attached drawings, the surface traveling mobile apparatus according to the

present invention can operate as a cleaning apparatus when cleaning equipment is provided, and can be used as an emergency rescue machine. For example, when a spray unit for spraying water or wash liquid is loaded inside or outside the surface traveling mobile apparatus, in addition to the rotating brush 300 shown in FIG. 9A, a cleaning apparatus is realized. In this case, water and wash liquid can be supplied from a rooftop or the surface of the earth through an additional rubber or plastic tube. Here, the rotating brush and the spray unit can be automatically operated by the microcomputer when the surface traveling mobile apparatus moves.

10       The structure and operation of the vacuum pump (30 of FIG. 1) applied to the surface traveling mobile apparatus according to the present invention will now be described in more detail with reference to the attached drawings.

According to FIGS. 11A and 11C for illustrating the structure and operation of the vacuum pump applied to the present invention, the vacuum pump includes a motor 32 for generating a driving force, a rotating permanent magnet 34 which is connected to the motor 32 on a shaft 31 and rotates, a fixed permanent magnet 36 which is repulsed or attracted by the magnetic force of the rotating permanent magnet 34, a vacuum chamber 38 including two openings 60 for air to pass through a pump 39 having a diaphragm which goes in and out of the internal space 37 of the vacuum chamber 38 due to the repulsion and attraction of the magnet 36, directional valves 62 and 62' for passing the air in one direction by the driving of the pump 39. Accordingly, the air of the vacuum chamber 38 moves in one direction. The rotating magnet 34, in which the N pole and the S pole are alternately arranged, is cylindrical. When the rotating magnet 34 rotates, the repulsion occurs in the case where the pole of the rotating magnet 34 and the pole of the fixed magnet 36, which are next to each other, are the same, and the attraction occurs in the case where the pole of the rotating magnet 34 and the pole of the fixed magnet 36, which are next to each other, are different. When the pole of the rotating magnet

34 is the same as the pole of the fixed magnet 36, the fixed magnet 36 is pushed into the vacuum chamber 38 together with the diaphragm of the pump 39, thus compressing the volume of the vacuum chamber 38 so that the exhausting valve 62' is opened. Therefore, the air is exhausted from the vacuum chamber. When the pole of the rotating magnet 34 is different from the pole of the fixed magnet 36, the fixed magnet 36 is attracted by the rotating magnet 34. Accordingly, the pump 39 comes out of the vacuum chamber 38 and thus, the volume of the vacuum chamber 38 expands and the inlet valve 62 opens. Therefore, the air enters the vacuum chamber. In FIGS. 11A through FIG. 11C, processes where the air in the vacuum chamber is inhaled and exhausted by the repulsion and attraction of the rotating magnet and the fixed magnet are explained. However, a vacuum pump of a high performance, which is used in dental clinics, can be used.

FIGS. 12A through 12D illustrate the proceeding, receding, and direction changing movements of the surface traveling mobile apparatus according to the present invention. FIGS. 12A through 12D are bottom views of the surface traveling mobile apparatus according to the present invention. A driver for transmitting power to the endless track belts is shown between the endless track belts. In the driver, motors M1 and M2 for driving the belts of the respective sides are schematically connected to pulleys P1 and P2. Accordingly, the driving force of the motors is transmitted to the belts. As shown in FIG. 12A, when the driving forces of the motors M1 and M2 are provided to the belts in the same traveling direction and with the same magnitude, the surface traveling mobile apparatus travels in the arrow direction A1. As shown in FIG. 12B, when the driving forces of the motors M1 and M2 are provided to the belts in the same receding direction and with the same magnitude, the surface traveling mobile apparatus recedes in the arrow direction A2. As shown in FIG. 12C, when the driving force of the motor M1 is larger than the driving force of the motor M2 and the direction of the driving force of the motor M1 is opposite to the direction of the driving force of the motor M2, the surface traveling

mobile apparatus changes the traveling direction into the arrow direction A3 which is the rotation direction of the motor M1. As shown in FIG. 12D, when the driving force of the motor M1 is smaller than the driving force of the motor M2 and the direction of the driving force of the motor M1 is  
5 opposite to the direction of the driving force of the motor M2, the surface traveling mobile apparatus changes the traveling direction into the arrow direction A4 which is the rotation direction of the motor M2. The proceeding, receding, and direction changing methods of the surface traveling mobile apparatus according to the present invention can be  
10 realized by those skilled in the art using the same method by which common traveling mobile apparatuses proceed, recede, and change directions. Therefore, a detailed description thereof will be omitted.

FIG. 13 schematically shows an example, in which the surface traveling mobile apparatus according to the present invention cleans a  
15 vertical window. As shown in FIG. 13, an example of a cleaning apparatus using the surface traveling mobile apparatus according to the present invention has a structure similar to those illustrated in FIGS. 9A through 10D. It is schematically shown that the cleaning apparatus cleans the surface, while climbing a window or a marble wall 10'. The spray unit for  
20 spraying water and the wash liquid is not shown in FIG. 13 for the convenience of explanation. As shown in FIG. 13, the cleaning apparatus according to the present invention adopts a structure advantageous to traveling on vertical walls and over obstacles, in which the bottom surface of the surface traveling mobile apparatus is vacuum attached to the vertical  
25 wall and the surface traveling mobile apparatus moves by the constriction and expansion of the boom. A driver 302 for driving the rotating brush 300 for cleaning the surface can be further included. The articulated apparatus 200 adopted in the cleaning apparatus is driven by the driver 206 and preferably includes various sensors for sensing obstacles and determining  
30 dirty and clean areas. Since it is apparent to those skilled in the art that various methods of realizing the operation of the cleaning apparatus exist,

description of detailed embodiments thereof will be omitted and the concept thereof will be briefly explained. For example, a device for supplying and spraying water and the cleaning solution can be included inside or outside the cleaning apparatus.

5 In order to operate the cleaning apparatus according to the present invention, the wall or the window must be designed to withstand the load of the cleaning apparatus. However, the load of the cleaning apparatus can be various according to design. When a sensing code such as a transparent bar code for displaying limit load is engraved on the wall or the  
10 window and a sensor for sensing the code is included in the cleaning apparatus, it is possible to determine whether the cleaning apparatus can clean the surface in a state where the surface withstands the load of the cleaning apparatus. This will be briefly described with reference to FIGS. 14A and 14B which are a plan view and a side view, respectively, of a  
15 window to which a transparent bar code, which transmits visible light and totally reflects certain infrared wavelengths, is attached.

As shown in FIG. 14A, a load limit displaying transparent bar code 140 is engraved in part of the surface 10. As shown in FIG. 14B, an invisible bar code 140 is printed on the side of the surface 10 and infrared  
20 rays 130 of 940 through 1500 nm are incident on the bar code 140. Accordingly, a visible ray V1 is transmitted and infrared rays IR1 of 940 through 1500 nm are retro-reflected.

FIG. 15 is a view of the underside of the traveling mobile apparatus according to the present invention, from which an endless track belt is  
25 omitted. As shown in FIG. 15, the surface traveling mobile apparatus according to the present invention is preferably symmetrical like a military tank and caterpillar equipment for construction work. In general, shock absorbers (a shock preventing unit) for preventing shocks in the gravitational direction are adopted in most traveling mobile apparatuses.  
30 However, in the case of the traveling mobile apparatus which travels against gravity according to the present invention, since the traveling

mobile apparatus may not smoothly travel on a surface when shocks are inflicted from left and right or up and down directions with respect to gravity, it is possible to prevent shocks by providing shock absorber structures 150 to a structure for connecting the wheels 40 on both ends of a traveling mobile apparatus frame 160 to each other. The shock absorber structure 150 is a three-dimensional suspension structure, which has a hub gear in the center and in which three shock absorbers are placed on each of the upper and lower ends of a circular plate or a square plate, fixed to the outer perimeter. Gears 152, reversible motors 154 for generating power and transmitting the generated power to the gears, single-directional gears 156 connected to the reversible motors, and vacuum pumps 156 for making the surface traveling mobile apparatus vacuum are included between the three-dimensional suspension structures so that the air flows from the front wheel to the rear wheel or from the rear wheel to the front wheel. The installation position of the vacuum pump 156 is different from the installation position of the vacuum pump 30. However, flow of the air occurs in one direction between the front wheel and the rear wheel depending on whether the surface traveling mobile apparatus proceeds or recedes. Though not shown, the air flows between the vacuum tube 60 and the vacuum pump 156. Accordingly, the same load is exerted on the body of the surface traveling mobile apparatus and caterpillar type wheels at any angle and position.

#### Industrial Applicability

As mentioned above, the surface traveling mobile apparatus according to the present invention and the cleaning apparatus using the same can smoothly travel on a flat plane, an inclined plane, a vertical wall, and a ceiling, and can clean the windows of high buildings automatically.

What is claimed is:

1. A surface traveling mobile apparatus which moves by an endless track belt installed to be wrapped around a case from end to end traveling on a surface by the rotation of wheels driven by a power source,  
5 the surface traveling mobile apparatus comprising:
  - vacuum chambers installed to be attached to the sides of the wheels;
  - a vacuum tube for connecting the vacuum chambers to each other;
  - a vacuum pump formed in part of the vacuum tube, the vacuum  
10 pump for inhaling and exhausting air; and
  - suction mechanisms installed along the endless track belt at predetermined intervals, valve driven by contacting the wheels, and vacuum attached to the surface by the vacuum pump inhaling and exhausting air.
- 15 2. The surface traveling mobile apparatus of claim 1, wherein the vacuum pump comprises:
  - a motor for generating rotatory force;
  - a rotating magnet, in which the N pole and the S pole are alternately  
20 arranged and which is rotated by the rotatory force of the motor, the rotating magnet for generating different magnetic fields;
  - a fixed magnet arranged to be opposite to the rotating magnet;
  - a pump having a diaphragm operating by the attraction and repulsion between the rotating magnet and the fixed magnet;
  - 25 a vacuum chamber, the air inside of which is pumped due to the movement of the diaphragm; and
  - directional valves installed in openings at both ends of the vacuum chamber, the one directional valves for permitting the pumped air to flow in one direction.
- 30 3. The surface traveling mobile apparatus of claim 1, wherein

each of the suction mechanisms comprises:

a hollow valve case formed to be integrated with the endless track belt;

a valve driver formed on part of the valve case and coming in and coming out from the valve case by contacting the wheels;

a lever operated by the valve driver coming in and coming out from the valve case;

a ball moving up and down in the hollow portion of the valve case by the operation of the lever;

a spring installed to contact the upper portion of the ball in the hollow portion, the spring for providing an elastic bias; and

a flexible body formed to be integrated with the lower portion of the valve case and vacuum attached to or detached from a surface by evacuating the air therein or supplying air thereinto through a lower O ring opening of the valve case due to the operation of the ball valve.

4. The surface traveling mobile apparatus of claim 3, wherein each of the suction mechanisms further comprises a separation preventing groove so that the valve driver in the valve case is not separated from the valve case.

5. The surface traveling mobile apparatus of any one of claims 1 to 4, further comprising an articulated apparatus having a boom, which can be telescopically extended and retracted, and a suction mechanism for being vacuum attached to and detached from a surface, which is formed at the end of a boom in the articulated apparatus, so that the surface traveling mobile apparatus safely travels on a rugged surface or over an obstacle.

6. The surface traveling mobile apparatus of any one of claims 1 to 4, further comprising a belt tension controlling apparatus for controlling the tension of the endless track belt in part of the surface traveling mobile

apparatus so that the surface traveling mobile apparatus safely travels a rugged surface or over an obstacle.

7. The surface traveling mobile apparatus of any one of claims 1  
5 to 4, wherein each of the wheels comprises:

grooves for preventing the wheel from being separated from the  
endless track belt when the wheel contacts the endless track belt; and  
an opening for letting air flow between the wheel and the suction  
mechanism to the vacuum chamber.

10

8. A cleaning apparatus for automatically cleaning a surface by  
being moved by a surface traveling mobile apparatus which moves by an  
endless track belt installed to be wrapped around a case from end to end  
traveling on the surface by the rotation of wheels driven by a power source,  
15 the cleaning apparatus comprising:

vacuum chambers installed to be attached and sealed to the wheels;  
a vacuum tube for connecting the vacuum chambers to each other;  
a vacuum pump formed in part of the vacuum tube, the vacuum  
pump for pumping air;

20

suction mechanisms installed along the endless track belt at  
predetermined intervals, valve driven by contacting the wheels, and  
vacuum attached to the surface by the action of the vacuum pump;

a spray means for spraying water or wash liquid on a surface when  
the surface traveling mobile apparatus moves; and

25

a rotating brush for washing the surface using the sprayed liquid.

9. The cleaning apparatus of claim 8, wherein the vacuum pump  
comprises:

a motor for generating rotatory force;

30

a rotating magnet, in which the N pole and the S pole are alternately  
arranged and which is rotated by the rotatory force of the motor, the

rotating magnet for generating different magnetic fields;

a fixed magnet arranged to be opposite to the rotating magnet;

a pump having a diaphragm operating by the attraction and repulsion between the rotating magnet and the fixed magnet;

5 a vacuum chamber, the air inside of which is pumped due to the movement of the diaphragm; and

directional valves installed in openings at both ends of the vacuum chamber, the one directional valves for permitting the pumped air to flow in one direction.

10

10. The cleaning apparatus of claim 8, wherein each of the suction mechanisms comprises:

a hollow valve case formed to be integrated with the endless track belt;

15 a valve driver coming in and coming out from at least part of the valve case by contacting the wheels;

a lever operated by the valve driver coming in and coming out from the valve case;

20 a ball moving up and down in the hollow portion of the valve case by the operation of the lever;

a spring installed to contact the upper portion of the ball in the hollow portion, the spring for providing an elastic bias; and

25 a flexible body formed to be integrated with the lower portion of the valve case and vacuum attached to or detached from a surface by evacuating the air therein or supplying air thereinto through a lower O ring opening of the valve case due to the operation of the ball valve.

11. The cleaning apparatus of claim 10, wherein each of the suction mechanisms further comprises a separation preventing groove so  
30 that the valve driver in the valve case is not separated from the valve case.

12. The cleaning apparatus of any one of claims 8 to 11, further comprising an articulated apparatus having a boom, which can be telescopically extended and retracted, and a suction mechanism for being vacuum attached to and detached from a surface, which is formed in the suction mechanism at the end of a boom in the articulated apparatus, so that the surface traveling mobile apparatus safely travels on a rugged surface or over an obstacle.

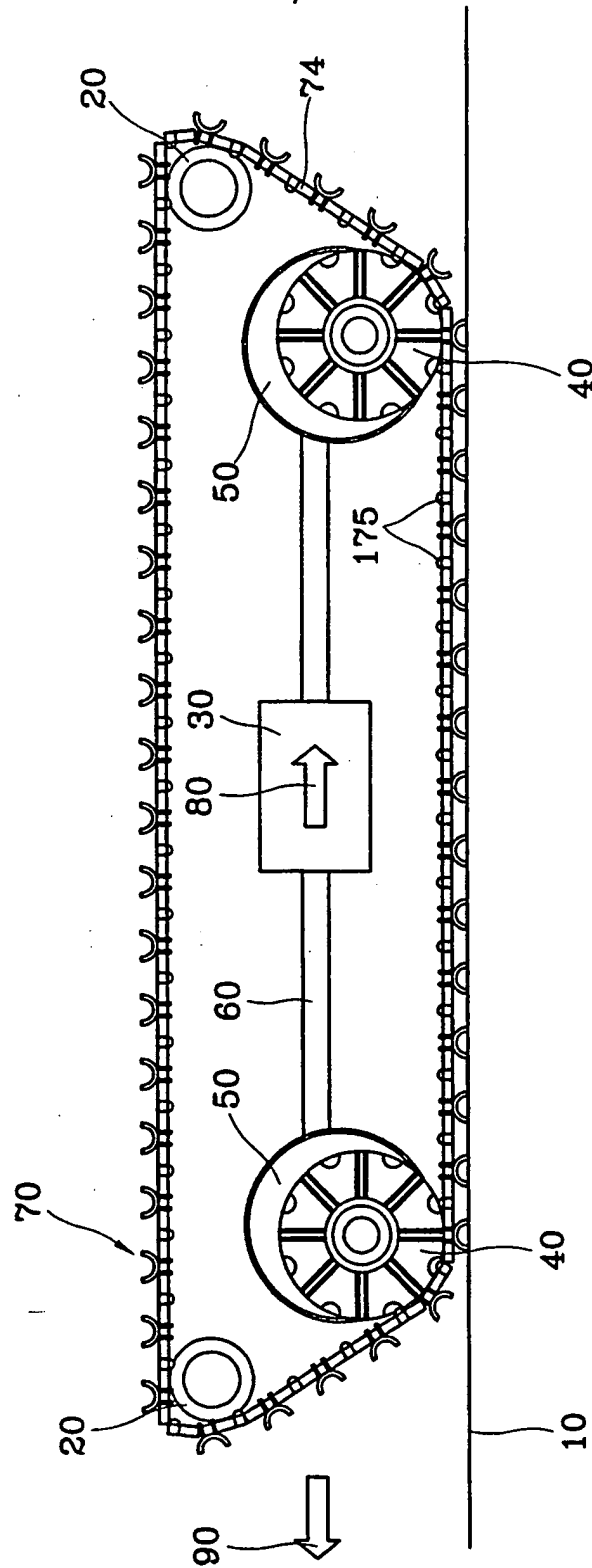
13. The cleaning apparatus of any one of claims 8 to 11, further comprising a belt tension controlling apparatus for controlling the tension of the endless track belt in part of the surface traveling mobile apparatus so that the surface traveling mobile apparatus safely travels a rugged surface or over an obstacle.

14. The cleaning apparatus of any one of claims 8 to 11, wherein each of the wheels comprises:  
grooves for preventing the wheel from being separated from the endless track belt when the wheel contacts the endless track belt; and  
an opening for letting air flow between the wheel and the suction mechanism to the vacuum chamber.

15. The cleaning apparatus of any one of claims 8 to 11, further comprising a sensing apparatus for sensing a load limit display bar code printed on a surface.

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FIG. 1



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FIG. 2

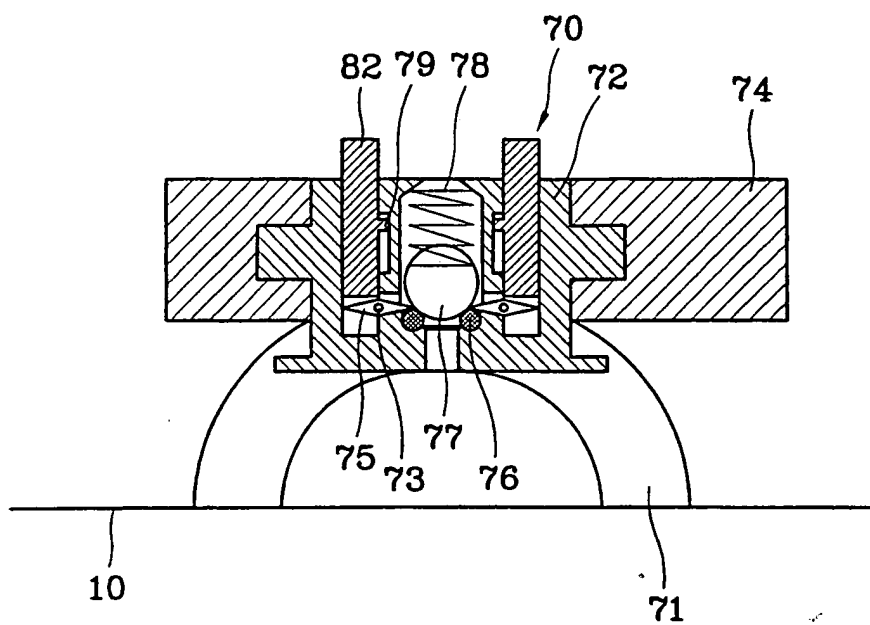
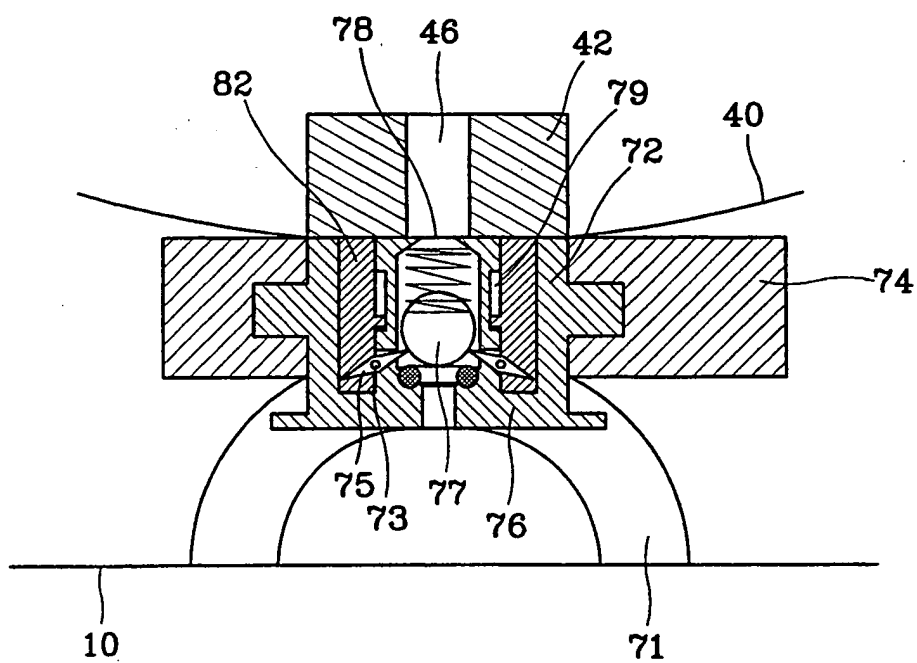


FIG. 3



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FIG. 4A

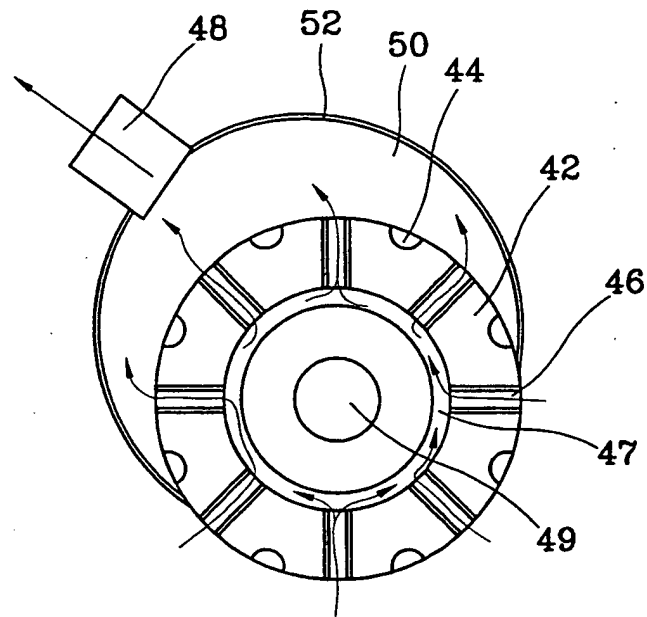
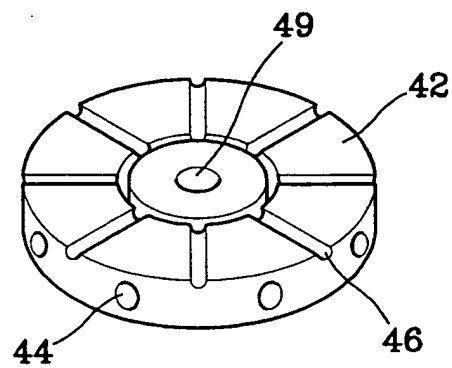
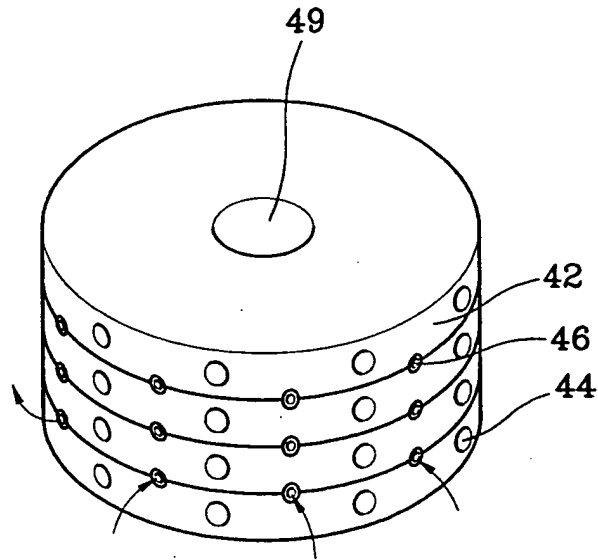


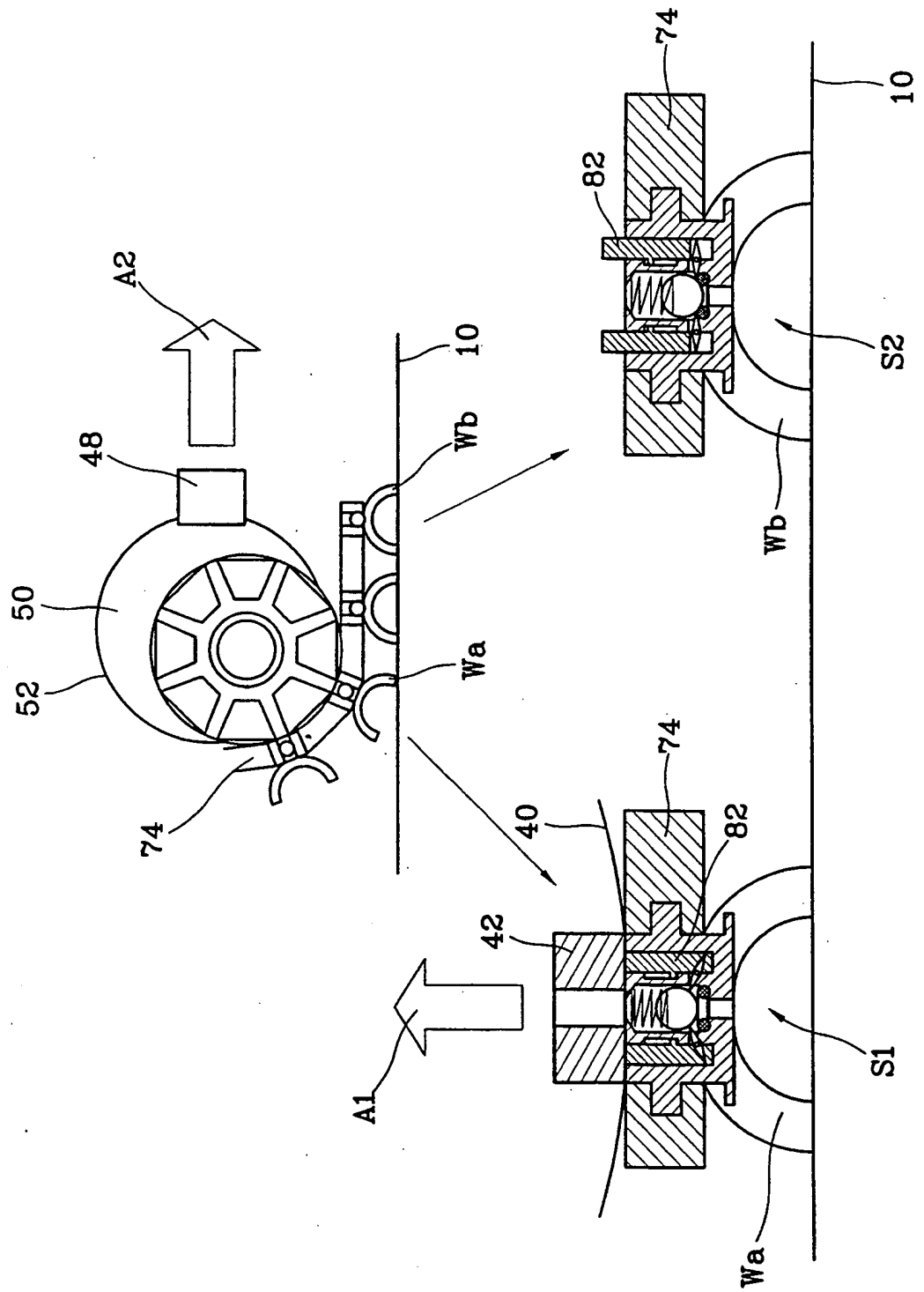
FIG. 4B



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FIG. 4C

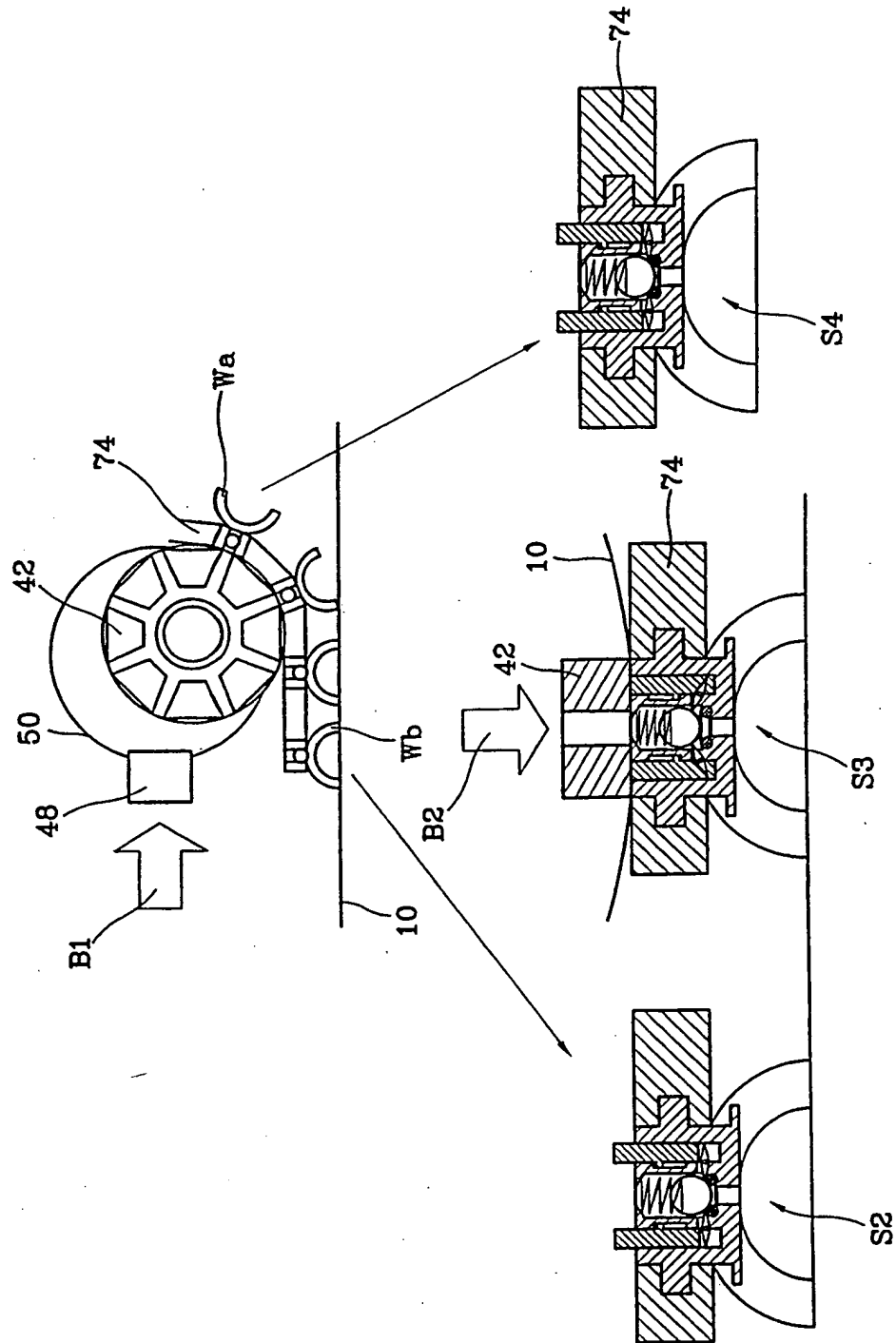
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FIG. 5

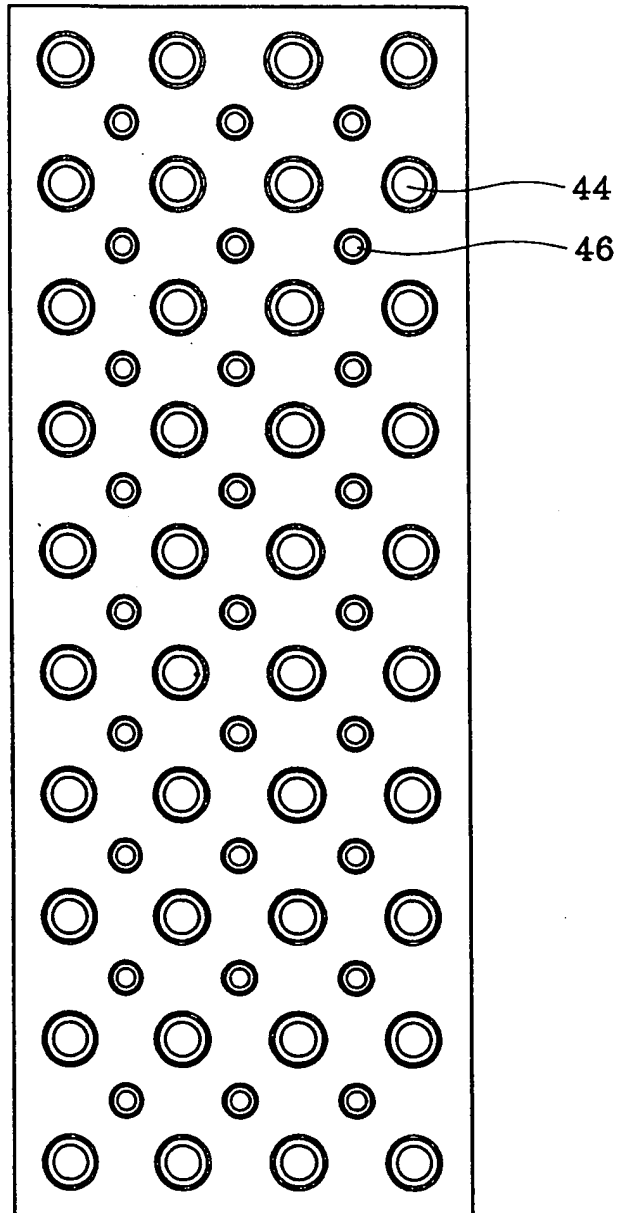


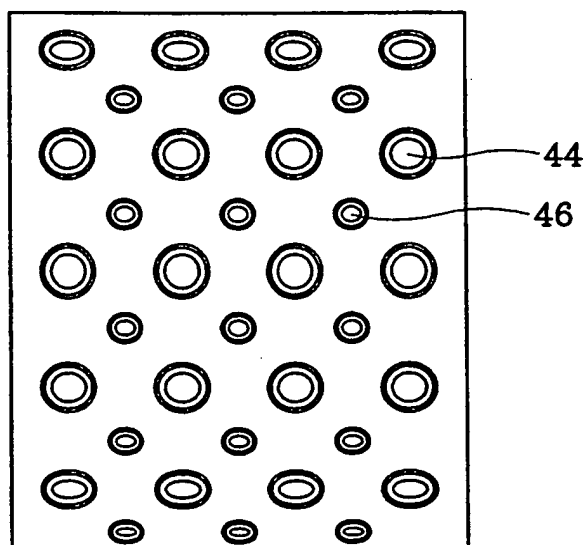
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FIG. 6



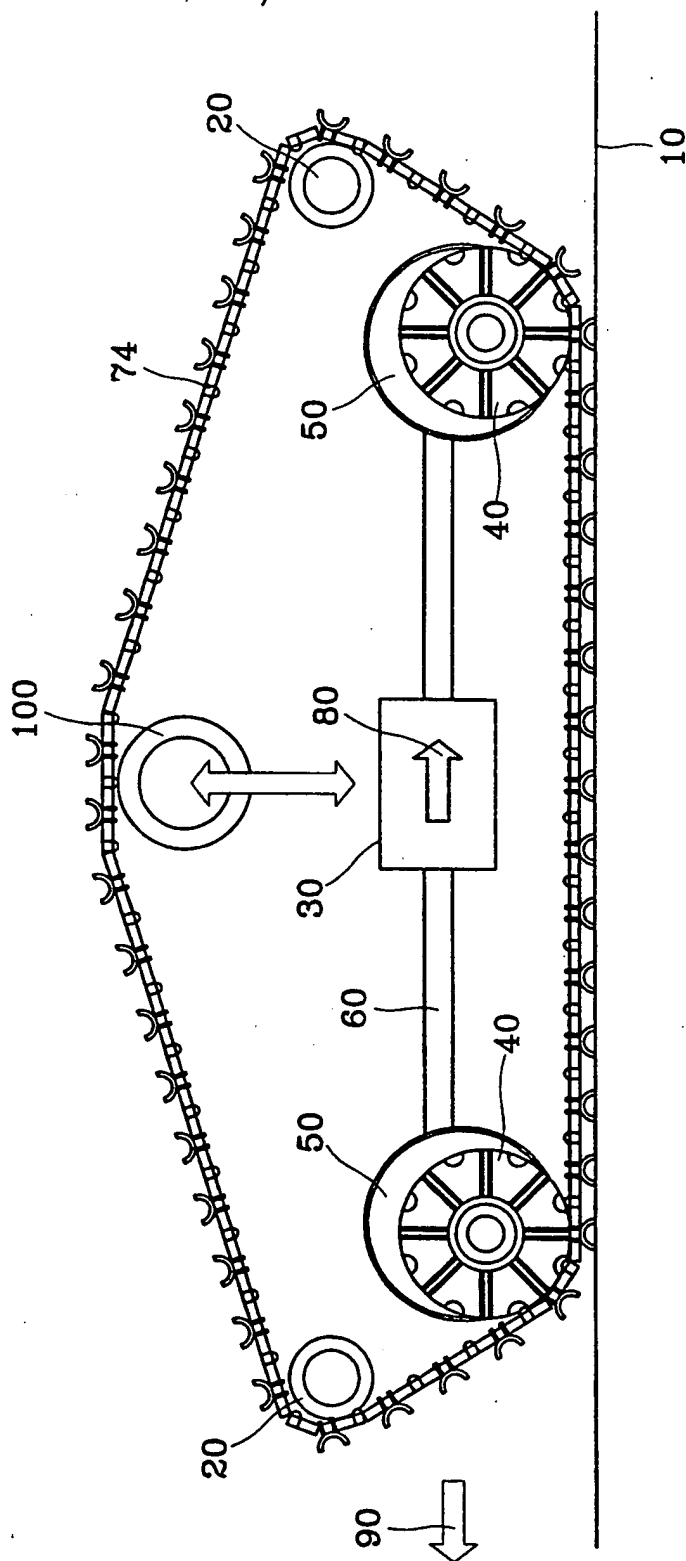
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FIG. 7A



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FIG. 7B

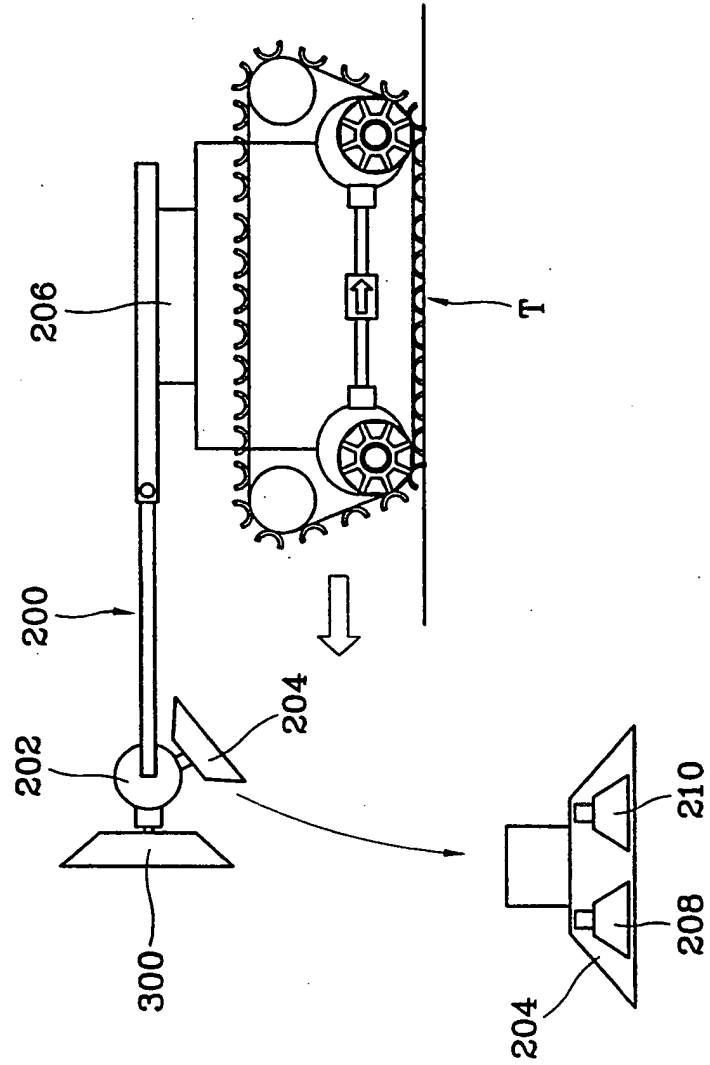
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FIG. 8



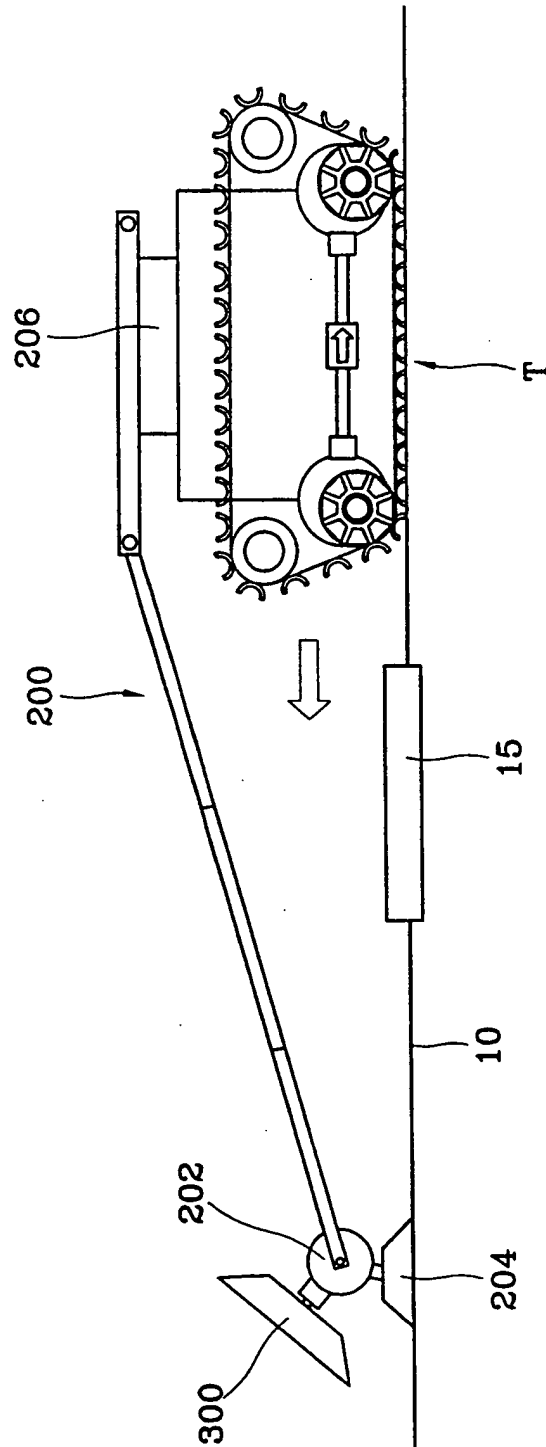
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FIG. 9A



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FIG. 9B



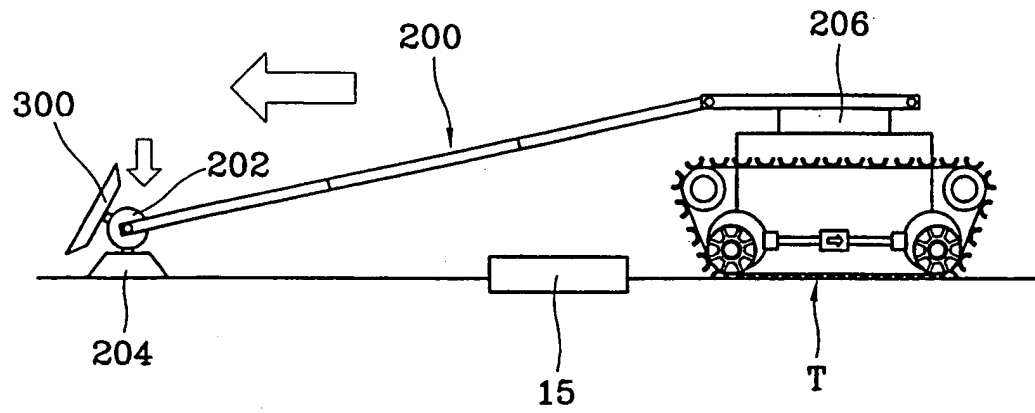
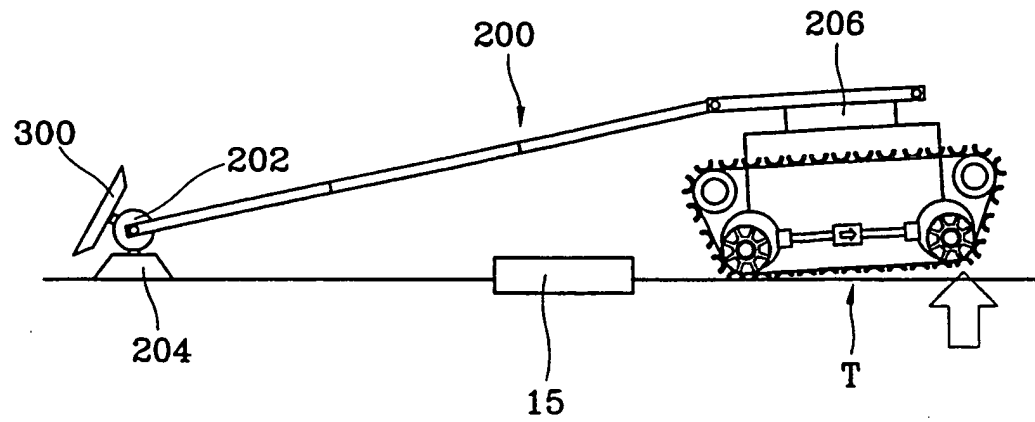
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FIG. 10A

FIG. 10B



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FIG. 10C

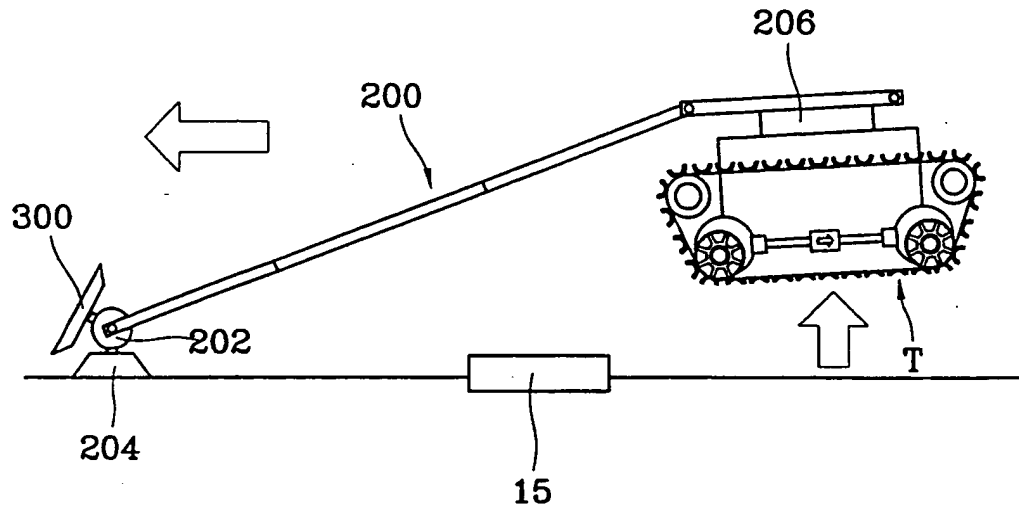
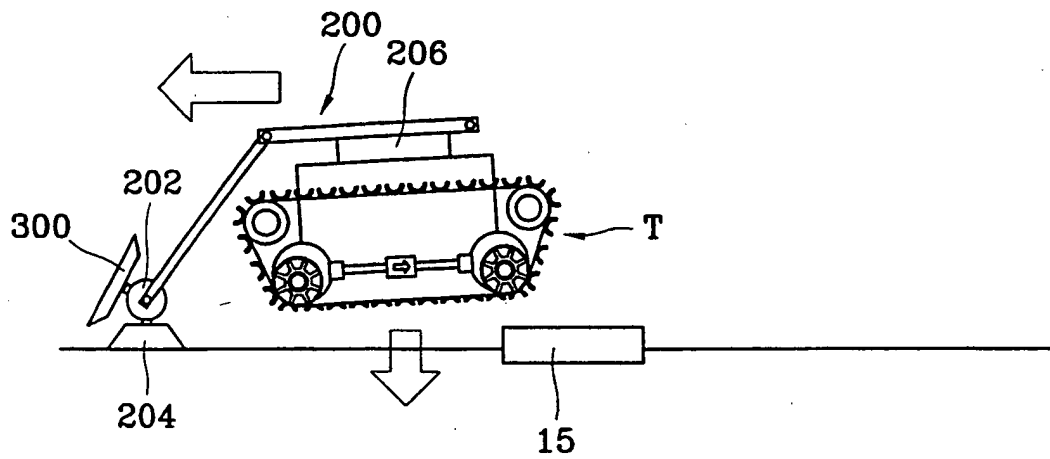


FIG. 10D



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FIG. 11A

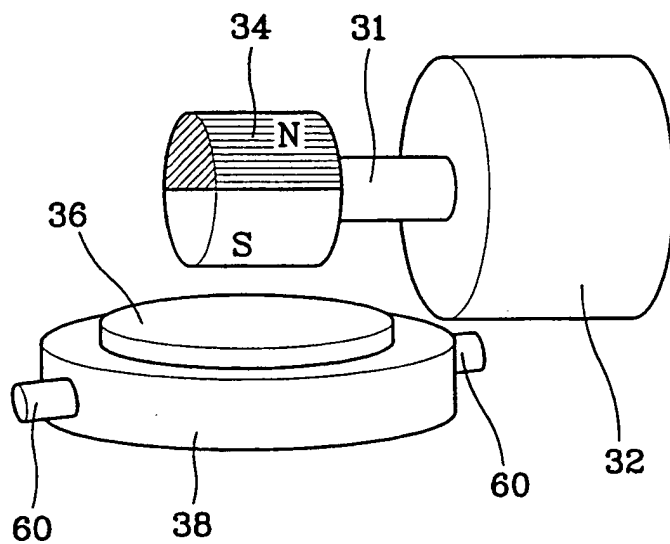
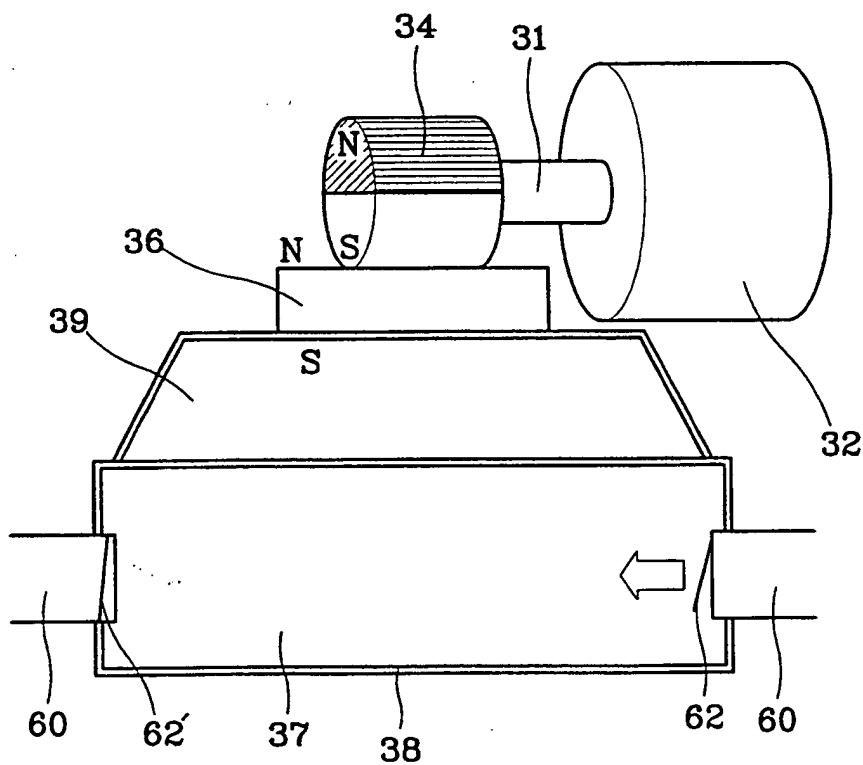
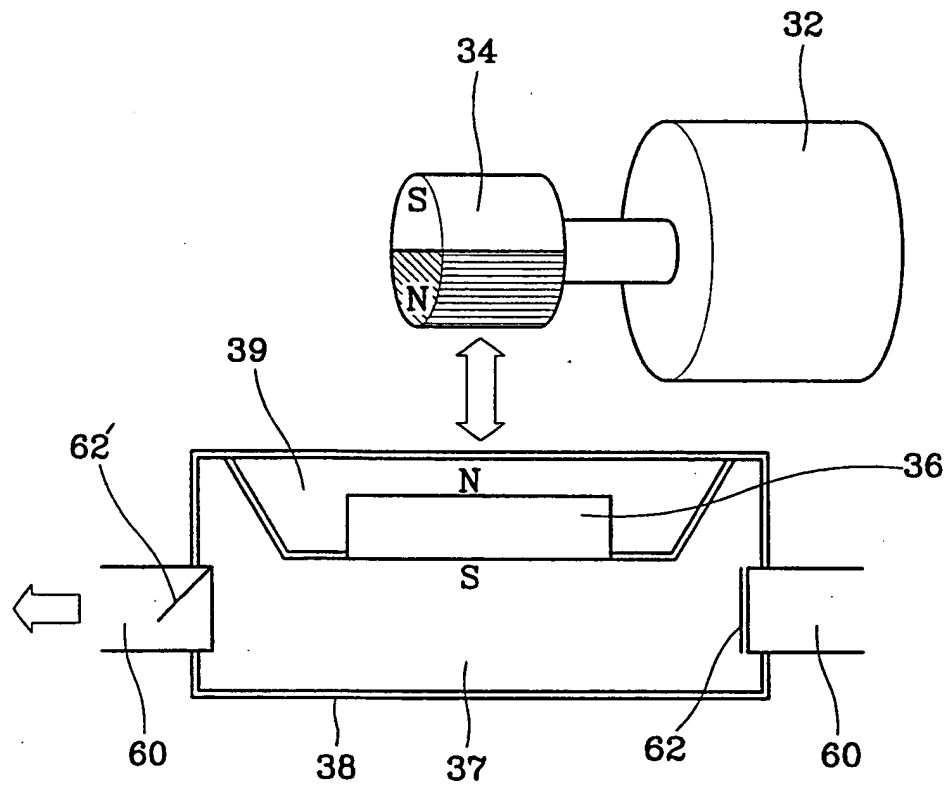


FIG. 1AB



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FIG. 11C

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FIG. 12A

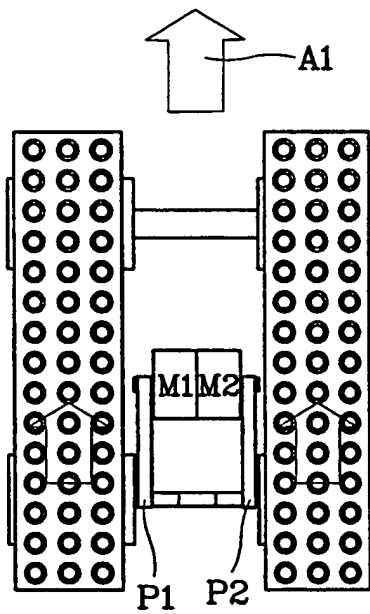
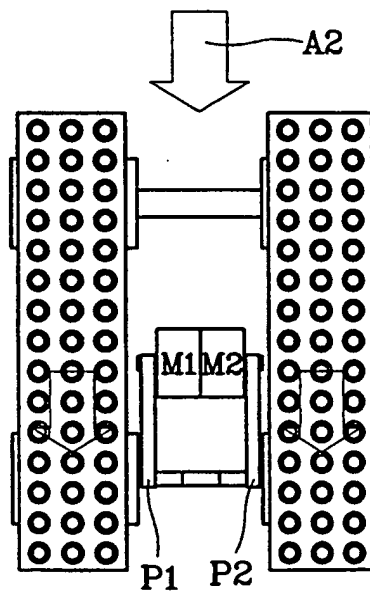


FIG. 12B



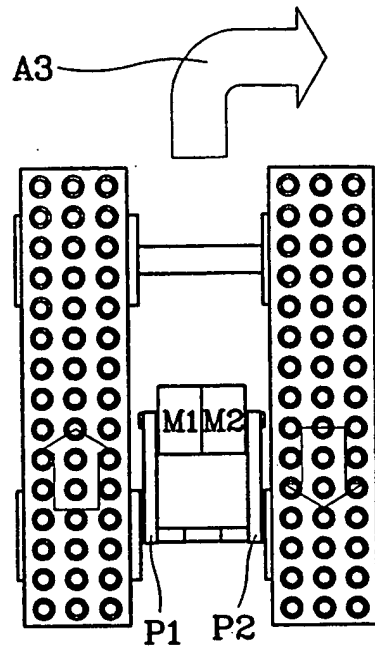
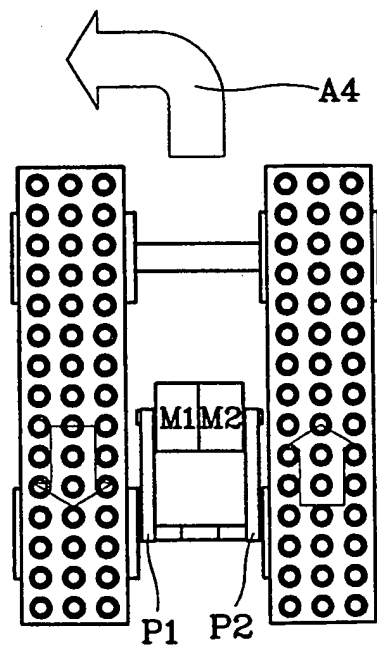
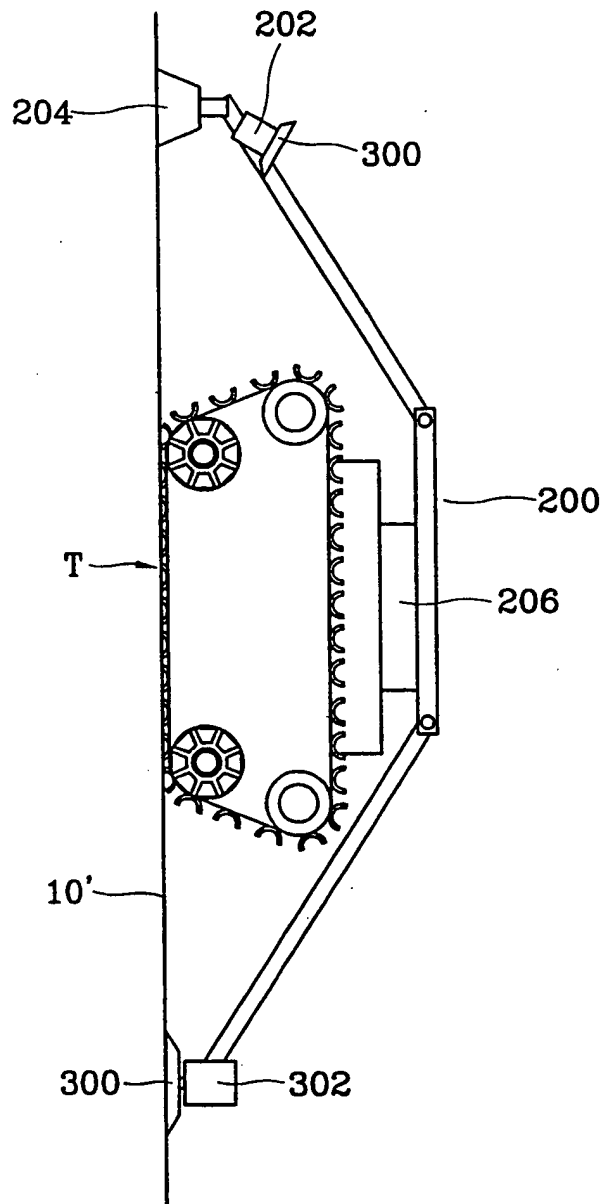
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FIG. 12C

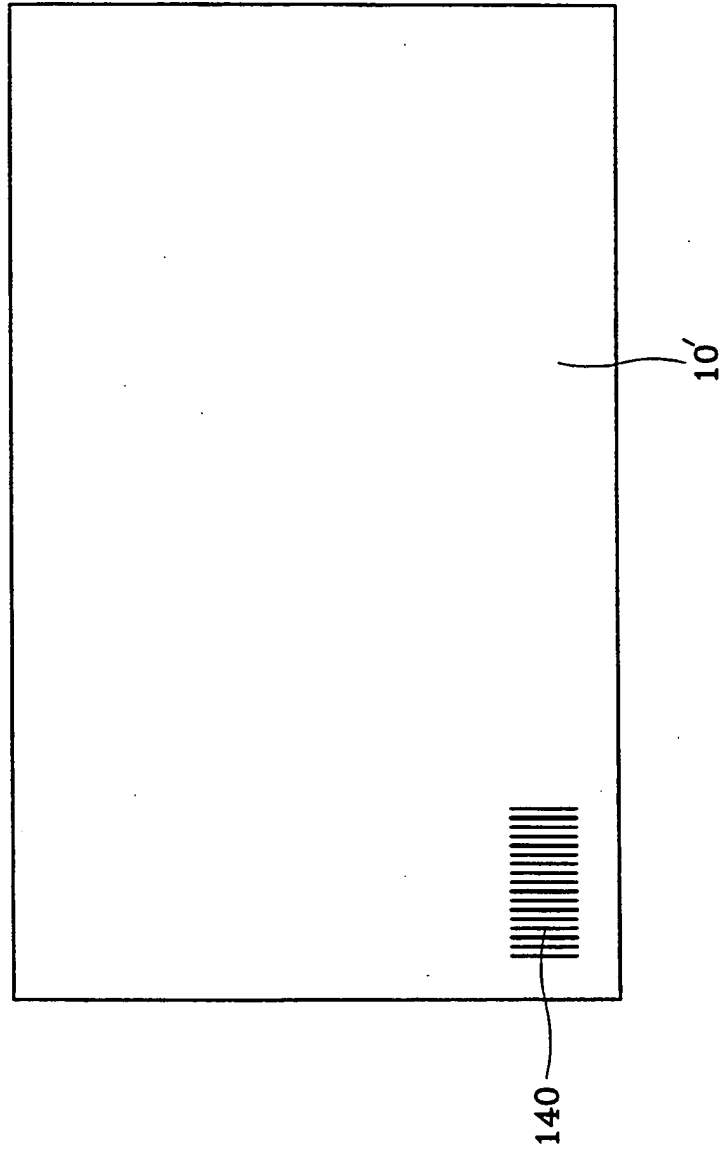
FIG. 12D

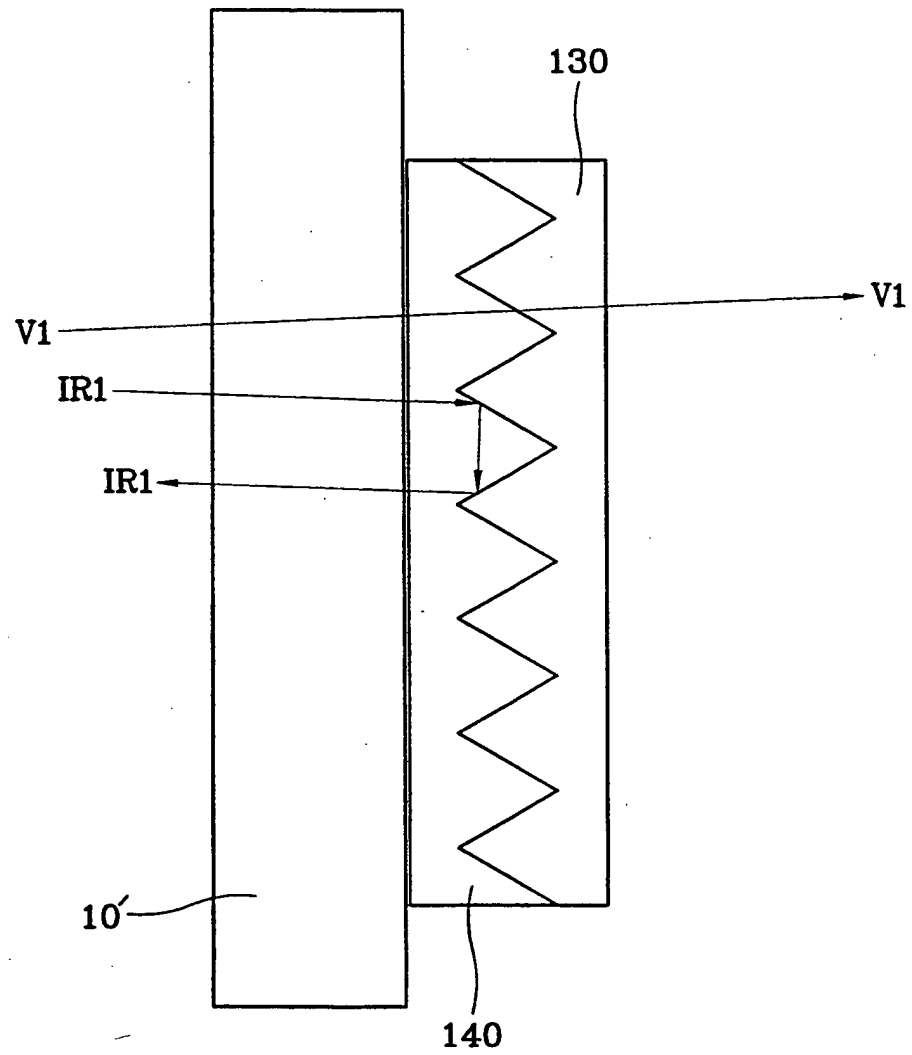


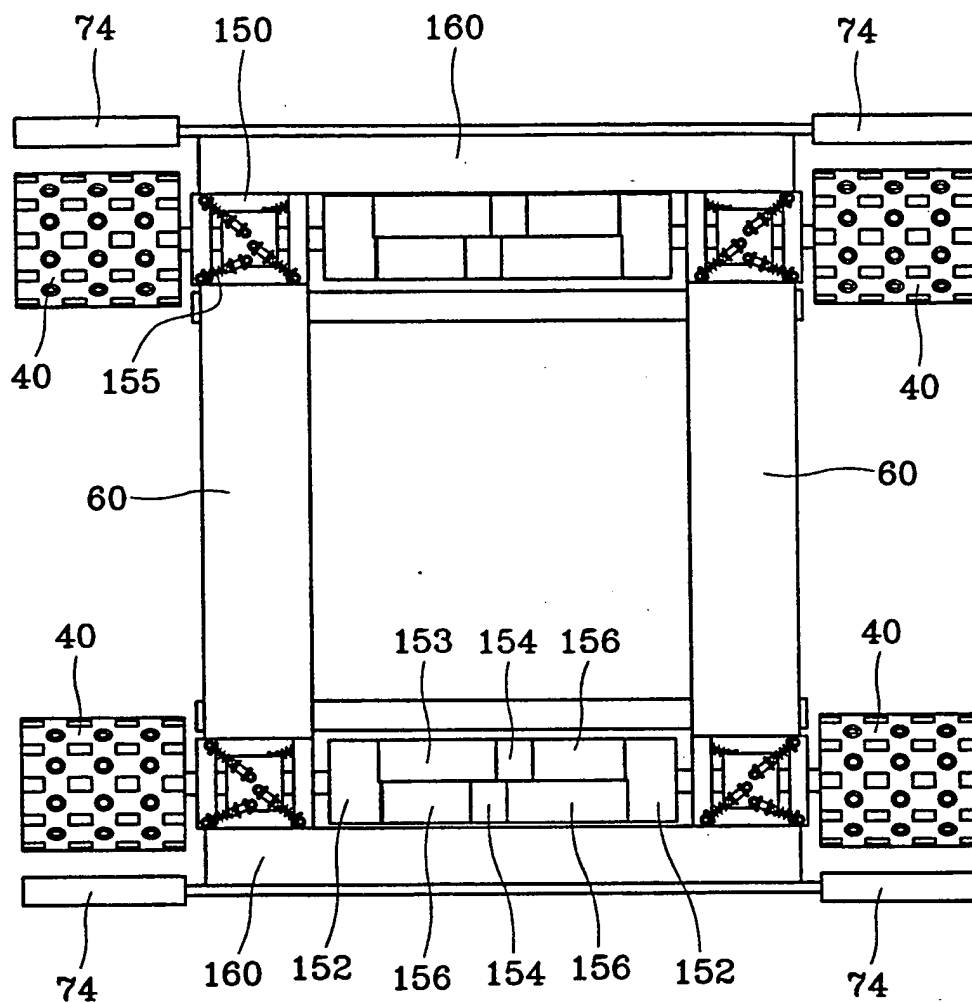
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FIG. 13

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FIG. 14A



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FIG. 14B

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FIG. 15

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/KR00/00571

**A. CLASSIFICATION OF SUBJECT MATTER****IPC7 B62D 57/02, A47L 11/30**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC7 B62D 57/02, A47L 11/30, A47L 11/40

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Korean Patents and applications for inventions since 1975, Korean Utility models and applications for Utility models since 1975  
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
PAJ, DERWENT "moving device & cleaning system"

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 61-46778 A (MITSUBISHI) 7 MARCH 1986 page 528, column 2, line 9 to 38	1
A	JP 4-104786 U (MITSUBISHI) 9 SEPTEMBER 1992 claim 1	1
A	JP 5-49554 A (TOSHIBA) 2 MARCH 1993 claim 1	8

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

15 SEPTEMBER 2000 (15.09.2000)

Date of mailing of the international search report

16 SEPTEMBER 2000 (16.09.2000)

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